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EVOLUTION AND GEOGRAPHIC DISTRIBUTION OF THE PROBOSCIDEA: MOERITHERES, DEINOTHERES AND MASTODONTS

BY HENRY FAIRFIELD OSBORN

My research on the Proboscidea began with my Fayûm expedition of 1907, participated in by Walter Granger and George Olsen. The thirteen following years, to 1920, were filled with continuous exploration, preparation of figures, preliminary bulletins and the important research of Matsumoto on the Fayûm Proboscideans. Since 1920, when my Titanothere Monograph went to press, intensive work on a comprehensive scale, continued for fourteen years, has led to the near completion of Volume I of the Proboscidea Memoir, the Moeritheres, Deinotheres and Mastodonts (in the largest sense of the word), all now in the present year 1934 in page proof. The elephantoid division will be treated in Volume II, publication of which is due in the year 1935.

The important biological results and conclusions have been summarized in a series of contributions to the National Academy of Sciences and the Society of Naturalists, including especially the idea that evolution is of two kinds, namely, (a) creative and originative, as well as (b) modification in the older sense known to Lamarck and Darwin.

The principal zoological results or researches on the Mastodontoidea may now be summarized as follows:

1. The Proboscidea originated exclusively in Africa, probably in Upper Cretaceous or Lower Eocene time.

2. Not remote from the stem which gave rise to the Sirenia, they were from the first distinguished by specialization of the second incisor teeth above and below, also by the power of forming transverse ridge crests whose number, especially in the third superior and inferior grinders, rises from primitive 2½–3 crests to 30 ridge crests.

3. The conversion of a broad prehensile upper lip of the hippopotamus

type in the Moeritheres into the broad prehensile upper lip of many of the Mastodonts, finally into the true proboscis of certain mastodonts and of all the stegodonts and elephants.

4. The adaptive radiation through all habitats from the purely aquatic and amphibious habitat of the Moeritheres, through swamp living, river border living, shallow lake border living, savannah living, forest living, tundra living

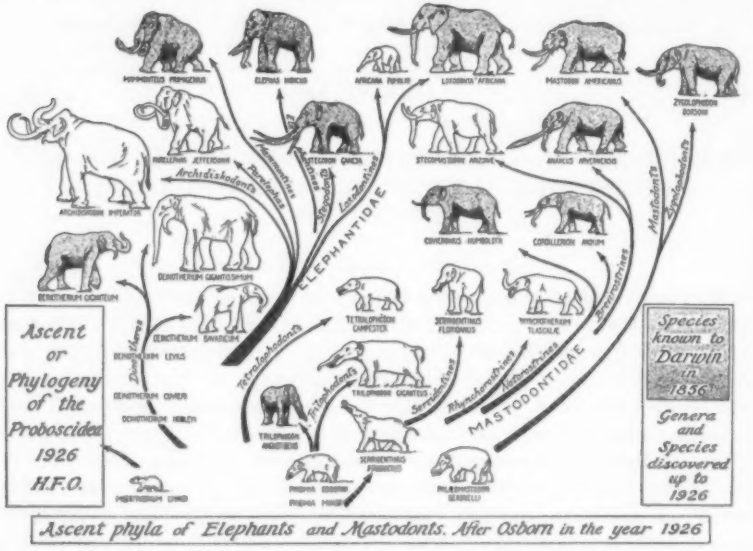


FIG. 1. PROBOSCIDEAN PHYLA OR LINES OF DESCENT, 1926

Shading: Species of *Elephas*, *Mastodon* and *Deinotherium* known to Darwin up to the year 1856.

Outlines: Genera and species known to Osborn up to the year 1926.

In Darwin's time all the Mastodontoids were embraced within the single Cuvierian genus *Mastodon*. Darwin's *Mastodon* included only seven species in 1859 when he wrote his "Origin of Species;" it now (1934) includes twenty-three valid genera and not less than one hundred and eighty-two species, a very large number of species remaining to be discovered.

and desert living, from equatorial to boreal latitudes and from sea level to elevated mountain habitats; for example, the Andean mastodont.

5a. The genera are primarily distinguishable by the adaptations of the grinding teeth, which, when very carefully analyzed, are highly characteristic.

5b. By the respective adaptations of the superior and inferior incisive teeth to a very great variety of functions in Proboscidean habitats and modes of feeding. In the Deinotheres, in three kinds of shovel-tuskers, also in the

Rhynchotheres, the lower incisive tusks are far more important and diversified than the upper; whereas in many mastodonts and all the stegodonts and elephantoids the lower tusks disappear entirely, the lower jaw being correspondingly abbreviated; whereas also the superior tusks function first as offensive weapons of marked sexual variation, second as auxiliary feeding weapons of great importance excepting in one division of the elephantoids in which the gigantic superior tusks are withdrawn from utility and become only of sexual distinction and importance.

6. There is consequently an immense amount of parallelism, namely of closely similar specialized organs like the shortened jaw being independently produced in different phyla.

7. Coördinated with the various functions and forms of the superior and inferior grinders, with the various forms of the upper lip and proboscis, with the superior tusks, are not only the cranium and jaws, but the neck, backbone and the limbs. For example, the three types of mammoths—the tundra (*Mammonteus*), the north temperate (*Parelephas*), and the southern (*Archidiskodon*)—alike exhibit enormous incurved tusks, used only in combat or for special purposes, not as auxiliary feeding organs. In these three mammoths the backbone is very weak because it has little work to do as an auxiliary feeding organ, whereas in the African and Indian elephants and their relatives the backbone is extremely strong.

8. As to phylogeny or lines of ancestry or descent, the Proboscidea afford a complete revolution in our philosophy; never before has it been possible to follow so many lines of descent over such long periods of geologic time, noting the progressive adaptive changes in each line to gain a perfection of certain mechanisms at the loss of other mechanisms. In general specialization becomes more and more intense. For example, in the shovel tuskers, *Phiomia osborni* of the Oligocene of Egypt gives rise to the incredibly specialized *Amebelodon* of Nebraska; this is parallel with the flat-tusker (*Platybelodon*) of the Gobi Desert and of Nebraska in which the whole jaw is an enormous shovel, the upper jaw and skull being sacrificed and greatly reduced in size.

9. Ascending mutations, species and genera are principally defined by the adaptive changes in the grinding teeth and upper or lower incisive tusks. For the first time I am convinced as to exactly how long a period of geologic time it takes to produce a full-fledged and efficient adaptation, for the rate of adaptation varies enormously.

10. Finally I have for the first time come to definite conclusions as to exactly what all the classificatory terms mean, what an order means, a suborder, a super-family, a family, a sub-family, a genus, a species, an ascending mutation or subspecies.

11. The Linnaean system of classification based solely on zoological observation must now be replaced by a phylogenetic system in which all

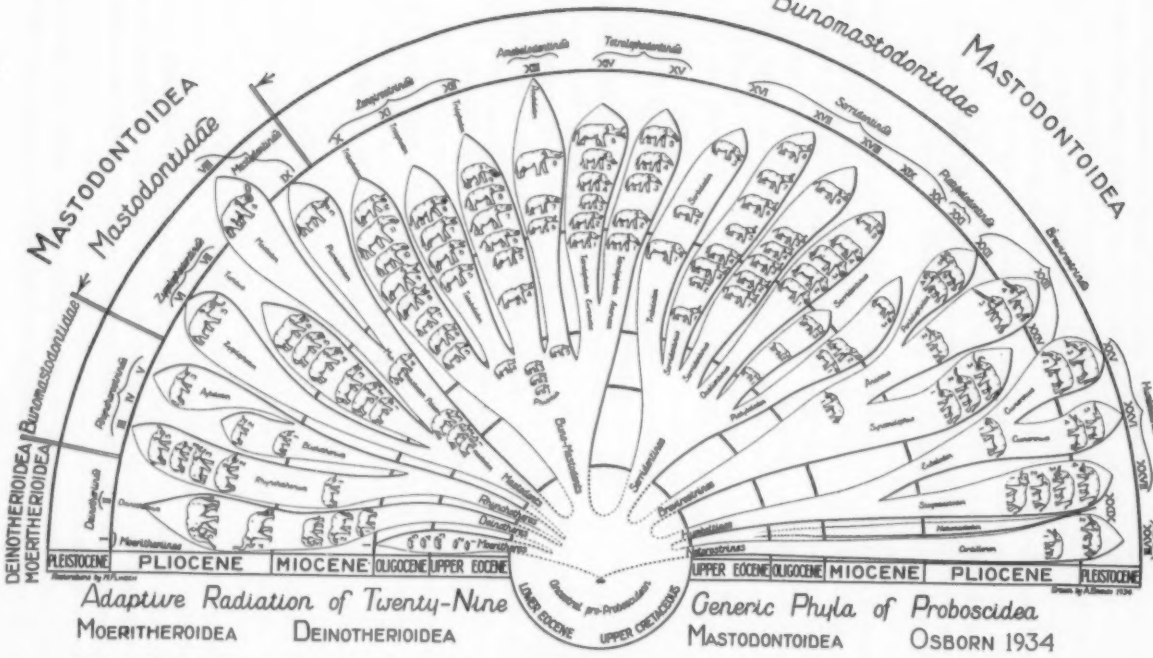


FIG. 2. PHYLOGENY OF THE MOERITHERIOIDEA, DEINOTHERIOIDEA, AND MASTODONTOIDEA, AS OF JANUARY, 1934

Presented before The American Society of Mammalogists at the meeting of May 11, 1934; the phylogeny of the Elephantoidea will be presented later in another chart. (Prepared for Volume I of the author's forthcoming monograph THE PROBOSCIDEA, now in press.)

divisions from the order to the sub-species are placed vertically as succeeding each other during millions of years of geologic time, rather than horizontally as observed in recent or existing time by Linnaeus and other zoologists. The phylogenetic scheme set forth in the Titanothere Monograph (Osborn, 1929: vol. I, fig. 14, page 16) is literally fulfilled in one of the complex series of mastodonts known as the Serridentinae (Cf. fig. 2, XVI–XXI).

We may now give a synopsis of the concrete application of these eleven principles accompanied or followed by the illustrations.

Referring to the chart (fig. 2) it will be observed that the Proboscidea divide into four great suborders which were widely differentiated from each other in upper Eocene time, as follows:

Sub-order: MOERITHERIOIDEA, primitive aquatic Proboscideans intermediate in habit between the Hippopotami and the Sirenia, with simple conical or partly ridge-crested grinding teeth, upper and lower incisors abrading each other as in the rodents.

Sub-order: DEINOTHERIOIDEA, including the Deinotheres with very large down-turned inferior tusks, no superior tusks; with sharply crested grinding teeth, usually with two and, rarely, three transverse ridge crests; with elephantine bodies.

Sub-order: MASTODONTOIDEA, invariably with superior tusks, with or without inferior tusks; typically with mastodontine bodies; with multiple ridge crests from three to eight in number either sharp or complicated with numerous foldings; secondary cones.

Sub-order: ELEPHANTOIDEA, without inferior tusks; with very large superior tusks lacking enamel, invariably with elephantine body and strongly developed proboscis; ridge crests evolving from five transverse ridge plates into thirty in posterior molars.

The earliest of these grand divisions to appear in geologic history are the Moeritheres, embracing five species known in the fluviatile and marine deposits of the north shore of Africa, and not leaving any descendants as far as known.

The second division is formed by the Deinotheres, first appearing in an undescribed Middle Miocene species recently discovered by Leakey from the heart of Africa, evolving through five known specific stages into the gigantic *Deinotherium gigantissimum* of Rumania, extending far eastward into India but not beyond.

The Rhynchotheres or the beak-jawed mastodonts first appear in the Middle Miocene of Egypt; they extend from the Middle to the Upper Miocene of India, thence, as shown in the accompanying chart (Fig. 2) they spread to California, Texas and Mexico, dividing into three sub-divisions theoretically adapted to different uprooting habits within forested areas, namely, the large typical *Rhynchotherium* with powerful jaws, the extremely slender jawed *Blickotherium* of Nebraska and Honduras, finally the still more slender jawed *Aybeledon* of Honduras in which the lower incisors entirely lack enamel.

This brings us to the more typical mastodonts believed to be exclusively forest living, first known in the *Palaeomastodon* of the Lower Oligocene of Egypt, then reappearing in the *Miomastodon merriami* of the Middle Miocene of Nevada, finally spreading all over North America in the familiar *Mastodon americanus*; a closely but not directly ancestral stage is the *Pliomastodon* of California. True mastodonts resembling *Mastodon americanus* are also found in the forest deposits of Siberia.

Quite distinct is the less sharply crested *Zygolophodon* of western Eurasia which becomes extinct in the forests of northern Italy and Great Britain; this is the *Zygolophodon borsoni* of Hays.

Still more sharply crested with smaller tusks are the six species of the genus *Turicius* named after the locality of the first discovery, Zurich. This phylum extends from the Lower Miocene of France into the Lower Miocene of Switzerland, Germany and Greece.

The next grand division is that of the Longirostrines or long-jawed mastodonts in all of which the inferior incisors at the end of long slender mandibles functioned for digging and uprooting purposes chiefly, we believe, along river shores and shallow lake bottoms. These divide according to their special functions into four series, all of which may have sprung from the Upper Oligocene *Phiomia*, named after Lake Fayûm of northern Egypt. Since the lower incisors are so effective in the prehension of various kinds of food, the grinding teeth remain comparatively simple and only three crests are developed on the second and third inferior and superior molars, hence the name *Trilophodon*. This four-fold adaptation may be summarized as follows:

(X) Nine species ranging from the small *Phiomia pygmaeus* of the Upper Oligocene of Algeria into *Trilophodon angustidens gaillardi* of the Lower Pliocene of France, through the Trilophodonts of the Lower Miocene of Baluchistan, and of the Middle Miocene of India and of Germany.

(XI) The oblique-tuskers with large incisors; including four species from New Mexico, Nebraska and South Dakota.

(XII) The third division, now known in America exclusively, are the prod-tuskers in which the incisors are rounded. They begin with the *Trilophodon fricki* of the Middle Miocene of Colorado and extend into the excessively long-jawed *Trilophodon lulli* of the Middle Pliocene of Nebraska.

(XIII) Finally, there are the extraordinary shovel-tuskers arising in the *Phiomia osborni* of the Middle Oligocene of Egypt and evolving into the remarkable *Amebelodon fricki* of the Upper Pliocene of Nebraska; these shovel-tuskers constitute the most ancient and one of the most highly specialized of three distinct phyla of mastodonts which frequented shallow lake borders.

Contemporary with the Trilophodonts are the Eurasiatic (XIV) and American (XV) Tetralophodonts in which the intermediate molars have four ridge crests. The geographic division is artificial because early European

and American species are closely similar. First known in the Lower Pliocene *Tetralophodon longirostris* of Germany the Eurasiatic division comprises migrating stages in Persia, India, Java and China, certain of which are closely similar to the earlier known forms of *Tetralophodon* in Texas. The American Tetralophodonts extend from the Lower Pliocene *Tetralophodon fricki* of Texas to the Upper Pliocene *Tetralophodon* (*Morrillia*) *barbouri* of Nebraska, the latter with greatly elongated teeth.

Still more widely differentiated are the six generic phyla (XVI–XXI) embraced within the family Serridentinae or serrate-toothed mastodonts, further distinguished by jaws somewhat less elongate and more powerful than those of the Longirostrines mentioned above; these animals were for a century confused with *Trilophodon*. They are frequently found fossil in lignites. It now appears that their typical habitats were the forests and forest borders, whereas Trilophodonts frequented lake or river borders; yet one branch, *Serridentinus serridens*, radiated into the plateau deserts of Texas, Colorado and Nebraska. Another branch, *Ocalientinus*, frequented Mongolia (*Ocalientinus florescens*), Florida (*Ocalientinus floridanus*), Kansas (*Ocalientinus republicanus*) and New Mexico. Still more remarkable Serridentines are the extraordinary and highly specialized shovel-tuskers (XXI) *Platybelodon*, of Mongolia (*Platybelodon grangeri*), of the north Caucasus (*Platybelodon danovi*) and finally of Nebraska (*Platybelodon barnumbrowni*).

The sixth and more recently discovered Serridentine shovel-tusker is the *Serbelodon burnhami* of California with the giant front teeth lacking the dentinal tubules which are present in *Amebelodon* and *Platybelodon*.

We now come to the mastodont division that never reached America, namely the Brevirostrinæ or short-jawed mastodonts typified by the *Anancus arvernensis* of southern France and giving off two widely aberrant branches, *Pentalophodon* (signifying five intermediate crests) of India, and *Synconolophus* (signifying closely compressed cones and crests) of India, the former described by Falconer and the latter discovered by Brown. All these Brevirostrines are distinguished by the extremely oblique torsion of their ridge crests and by the absence of supplementary foldings.

This brings us finally to a division distinguished by highly folded or ptychodont grinding teeth, by abbreviated jaws and by powerful upturned tusks originally known in the '*Mastodon*' *humboldtii* of Cuvier in the plains of the Argentine. Most welcome and astonishing is the discovery in Nebraska of the Middle Pliocene ancestral form *Eubelodon morrilli* which appears to have led directly upward into the two grand species of the Argentine, *Cuvieronius platensis* and *Cuvieronius superbus*; newly discovered and related mountain-living forms are the *Cuvieronius postremus* and *Cuvieronius ayorœ* of Ecuador, said to be associated with human remains. We owe to the keen observation of Cabrera the recognition, as belonging to this division, of Leidy's '*Mastodon*' *mirificus* discovered in Nebraska in 1858, properly renamed *Stegomastodon*

by Pohlig and rising through ascending mutations of *Stegomastodon texanus* and *Stegomastodon arizonæ* of Texas and Arizona respectively into the highly specialized *Stegomastodon aftoniæ* of the Lower Pleistocene of Iowa.

Finally the Cordilleras of Ecuador yielded to Humboldt in 1806 a single tooth which Cuvier named *'Mastodon' andium*, recently renamed *Cordillerion*; most welcome is the recent discovery of a closely related Californian ancestor *Cordillerion edensis*.

FIG. 3. ANCESTRAL MASTODONTS AND MOERITHERES OF THE PRIMITIVE NILE RIVER

Phiomia osborni (right), primitive shovel-tuskers, ancestral to the shovel-tuskers *Amebelodon* of Nebraska. *Palæomastodon* (upper left), primitive Mastodonts, ancestral to the true Mastodonts of Eurasia and North America. In the foreground are two Moeritheres, aquatic, hippopotamus-like Proboscideans.

In the above all too brief summary of our present knowledge of the Moeritheres, Deinotheres and Mastodonts, no accounts have been given of the explorations and researches of Barbour, Barnum Brown, Frick, Spillmann, Gidley, Borissiak, Andrews and Granger which have rendered possible this complete revolution in our knowledge of the mastodontoid Proboscidea. This communication to the mammalogists will, it is hoped, soon be followed by the appearance of Volume I of the Proboscidea Memoir.

The American Museum of Natural History, New York, N. Y.

FREQUENCY DISTRIBUTION OF LITTER SIZE IN MICE

By Lucy J. Watt

Since very little has been written on the frequency distribution of the litter size in mice, and since these animals are often used in experiments that require a knowledge of average litter size, it seems advisable to publish data on the subject, collected over a period of nearly a year, and to bring together scattered data of other investigators for purposes of comparison and discussion.

The mice used in my investigations were taken from the Department of Anatomy's stock at Stanford University. They were chosen at random, and no particular attention was paid to the inheritance or previous sex history of mated pairs. The males were allowed to run with the females during the whole course of the experiment. In most cases the young were removed within a few hours after parturition. When this was not done no more than

TABLE 1

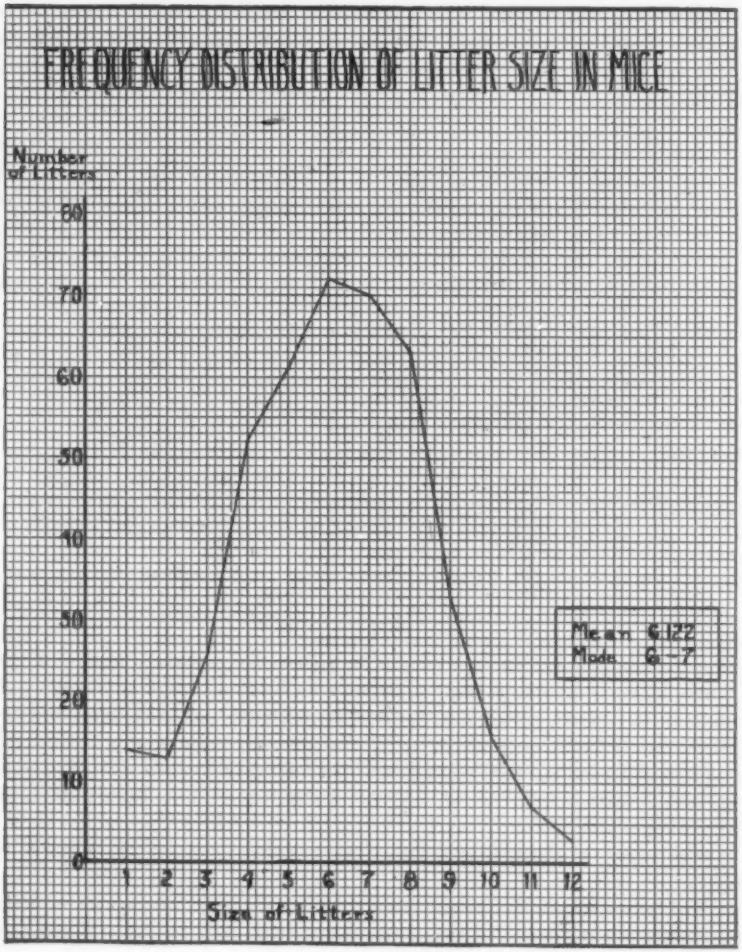
	NUMBER OF LITTERS	NUMBER OF YOUNG	AVERAGE LITTER SIZE	STANDARD DEVIATION
Robertson (1)	241	1,242	5.15	2.2
Dunn (2)	145		6.02	
	145		4.47	
Parkes (3)	267	1,795	6.72	2.5
MacDowell (4)	1,426		5.8	
Gates (5)	106	700	About 7.4	
Detlefsen (6)	993	4,508	4.54	
Danforth and deAberle (7)	500		5.86	
Watt	431	2,638	6.12	2.32

two were allowed to remain with the mother. These were removed when weaned, by the eighteenth day. The animals received a balanced diet, and were kept in a room heated during the winter months, so that the temperature remained fairly constant. In 431 litters raised, there was a total of 2638 young (including dead young), with an average litter size of 6.12, and a standard deviation from this of ± 2.32. These results have been plotted in the accompanying graph.

A comparison of these results with those of other investigators is given in table 1.

It will be seen from the above table that variations in average litter size, as reported by different investigators, range from 4.47 to 7.4. There are several things that might cause these variations. For instance, care must be taken to make the count as soon after birth as possible, because of a tendency of one or both parents to eat the young that die or are born dead. This cannibalism is especially apt to occur if there is overcrowding in the

cages. The low count obtained by Dunn (2) in one of his series (controls) may be accounted for in this way, for when pregnant females were isolated, the litter size tended to be much larger. In a majority of cases parturition



occurs at night or early in the morning; therefore, a count made in the morning at twenty-four hour intervals is advisable, because it will reduce the percentage of error on counts to a minimum.

The inheritance of mice must also be taken into consideration. Pure line strains among the Stanford collection varied greatly in this respect. An English gray variety consistently had larger litters, with a greater preponderance of litters of eleven and twelve than in other strains.

In another group of animals, the black-eyed whites, the litter size at birth was about average; but a few days after birth, the death of anaemic young, which constantly occurs in this strain, reduced the average size of the litter below normal (8).

A number of investigators have reported a litter size smaller than normal among yellow mice. This is apparently due to some factor associated with the yellow coat color, which, when inherited in the homozygous condition, is lethal. Danforth (8) has found that if the females of this strain were mated with normal males, the litters, though few in number, were consistently large (often 9 to 11); and even if the females were mated with "yellow" males, so that the lethal factor was able to express itself, the size of the litter tended to be more than three-fourths the average number. He believes, therefore, that the "yellow" female, although breeding infrequently, has the reserve to produce large litters when it does breed.

In the Stanford collection there is also a strain that produces monsters —the "Double" strain. Litter size in this group is decidedly below normal. (Average = 4.1 for 64 litters) (8).

A consideration of the foregoing facts illustrates the importance of considering the inheritance of mice used in studies where frequency distribution of litter size is of importance.

Parkes (9) has found that the prenatal mortality in animals suckling young during a concurrent pregnancy was sometimes as much as double the normal amount. He also observed that an immediately previous pregnancy is apt to increase the prenatal mortality. Both of these factors would therefore reduce the litter size.

Deficiency in vitamin E in the diet causes a lowering of the birth rate up to complete sterility, in higher animals, as has been demonstrated by a number of investigators (10).

Seasonal variations due to temperature changes is another factor that influences the size of the litter. Parkes (3) found that animals kept in unheated rooms did not breed at all during the winter months (November to February) while there was not much variation in litter size during the summer months. In animals kept at a fairly constant temperature, very little difference was found throughout the whole year. In the mouse colony at Stanford there is a falling off of litter size during the hotter summer months. In the winter the rooms are heated at night to keep the temperature uniform throughout the season, and at this time there is very little change in litter size, or in the number of litters. The above facts show that both extremes of temperature cause a falling off of the birth rate.

All other conditions being favorable, if the animals are badly troubled with external parasites, breeding ceases entirely (11) (12).

Perhaps the most important item causing variation in litter size is parity. Parkes (3) noticed that the first few pregnancies are more fertile than later ones, with a tendency for the second litter to be the largest. MacDowell (13), by counting the number of corpora lutea during the third week of pregnancy was able to determine not only the prenatal mortality for each litter, but also, accurate data on the average litter size. He found by this method that parity is more important in litter size than the age of the mother, for the former increases up to the third litter. From there on it remains about the same until the last few litters, at which time there is a decrease in size again.

It can be seen from the above discussion that the average litter size varies considerably, because of different factors, all of which must be taken into consideration when dealing with the subject. The strain should be known and pure. The previous sex history must be kept, and comparisons must be made on the basis of parity. Temperature and food should be well controlled, and the cages kept clean, and free from external parasites. Concurrent lactation should be avoided, and special care should be taken to make the counts early enough so that errors due to the devouring of the young by the parents will be reduced to a minimum. Then and only then can accurate conclusions on average litter size for a certain group of animals be made.

I wish to express my sincere appreciation to Dr. A. W. Meyer and to Dr. C. H. Danforth for the valuable aid that they have given me during the course of my investigations.

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BURROWS AND BURROWING HABITS OF THE DOUGLAS GROUND SQUIRREL

By Elton R. Edge

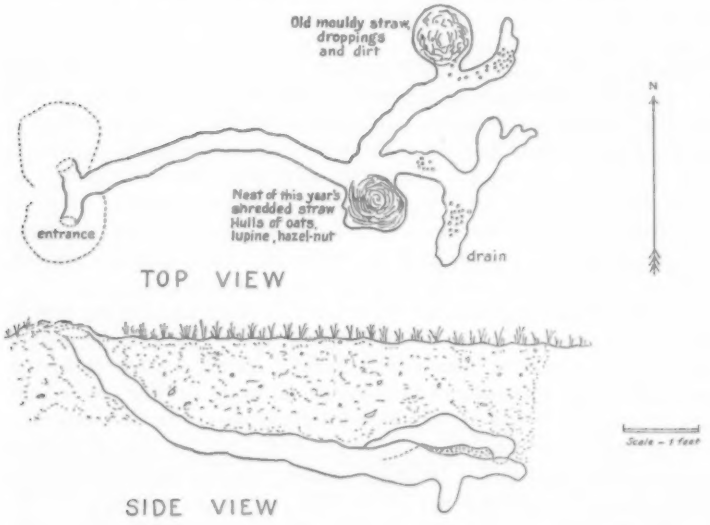
[*Plate 7*]

Grinnell (1, p. 647) stated in 1918 that as far as was known no one had made a complete excavation of the burrow system of the Douglas ground squirrel, *Otospermophilus douglasii*, and there appeared to be no published account dealing with their burrows. Therefore it seemed desirable to investigate this question. During the years 1929 and 1930, fourteen burrow systems were dug out in a variety of habitats in the general region of Eugene, Oregon. Measurements, sketches, and notes were made of all burrows excavated. In making the sketches and measurements a plane table, an alidade ruler, and a graduated measuring stick and line were used.

The Douglas ground squirrel burrows are almost always on sloping or well drained ground, perhaps because of an aversion on the part of the animal to dampness; or it may be that sloping ground affords a more satisfying reaction to the digging impulse of the squirrel. During the dry season burrows are occasionally found on low flats but these appear to be temporary and located there on account of food supply. This same low ground is often so saturated with water during the rainy season that any burrow would be completely flooded. Burrows are often close together, especially if the locality is favorably located for food, and the animals do not suffer too much from man and other enemies. A sheltered gully, about 200 yards long by 50 yards wide, on the coast near Cape Blanco, Oregon, (plate 7) contained more than 30 burrows, many of which had well worn entrances indicating recent occupation. This locality was pasture land, and it supported a good crop of grass with a fair supply of seeds and some berries in the late summer and fall. Another locality near Drain, Oregon contained more than 25 burrows. This also was a gully somewhat wider than the one previously mentioned and it was likewise pasture land. A small brook maintained a fair crop of grass until the middle of summer. In eastern Oregon, south of Dufur, a locality was found where squirrels and burrows were equally abun-

dant. This was along a dry pasture ridge bordering on a little stream and an alfalfa field. No doubt many other localities could be found where the squirrels were even more abundant and closely grouped. In general, pasture land seems to be the favored location, probably because the squirrels are subjected to less disturbance there than in cultivated fields. Southern exposure, because of more sunshine and warmth is more favored than northern; a small butte or knoll may have twenty or thirty burrows on its southern exposure and only three or four on the north side.

Plan and Elevation of Burrow of *Otospermophilus douglasii* in level oat stubble field
Springfield-Jasper road (Tryon's) Nov. 17, 1929. Soil - sandy loam, a little gravel.
Burrow was unoccupied, but was in use by above species. Oct. 13, 1929



There may not be much evidence of a mound at the entrance but there is generally a well defined path. The burrows are often located, apparently as a matter of safety, alongside a rock or stump. The shaft slants into the ground at an angle of about 35 degrees, the angle with the surface being greater on a sloping hillside. The shaft is usually carried in at the initial angle for about two feet. Then it flattens out horizontally. The horizontal section may continue six feet or more, depending largely on whether the digging is in loose or compact soil. The average depth of the shaft below the surface was two feet but there was considerable variability. Of the 14 burrows excavated, two extended in places to a depth of more than four feet

while three were not much over a foot deep. The burrows which extended deeper than four feet were of the intercommunicating type and seemed, judging from the number of filled-in shafts, to have been in use many years. The intercommunicating burrow system had two or more entrances but the ordinary burrow had only one entrance. The burrow shafts were seldom straight; frequent branches, apparently exploratory in nature, led off, some to higher or lower levels; old branches were often filled in by more recent digging. The average diameter of the burrows was slightly less than four inches, except where enlarged for a nest. The nest chambers were approximately ten inches in diameter and had the form of a flattened sphere. More than one nest chamber to a burrow was common, but only one was occupied or had been in recent use; often all were abandoned. The nest material was made up of fine grass, shredded straw, moss, leaves, and in one a quantity of meadow-lark feathers was found. Some of the nests were badly infested with fleas, *Ceratophyllus acutus* Baker?. The nests frequently contained food, such as blades of grass, grain, seeds of various plants, hazel nuts, and fruit pits. Where active storing was done it was usually in a passage way just off the nest. Hulls, rubbish, and feces were generally dropped in an abandoned nest or in a side gallery. Some of the side galleries or branches seem to be dug purposely as drains for they go almost vertically downward. Excavated material seems to be disposed of in several ways; old branches may be filled in; if the soil is loose some may be packed down against the sides and bottom of the burrow, or it may be dumped outside the burrow. Occasionally a mound outside the entrance may be of considerable size. Plate 7 shows a Douglas ground squirrel burrow in Sonoma County, California, where a large amount of broken rock has been brought out. In digging, the squirrel uses his forefeet, but some kicking out of dirt is done by the hind feet; the face is often used in pushing dirt.

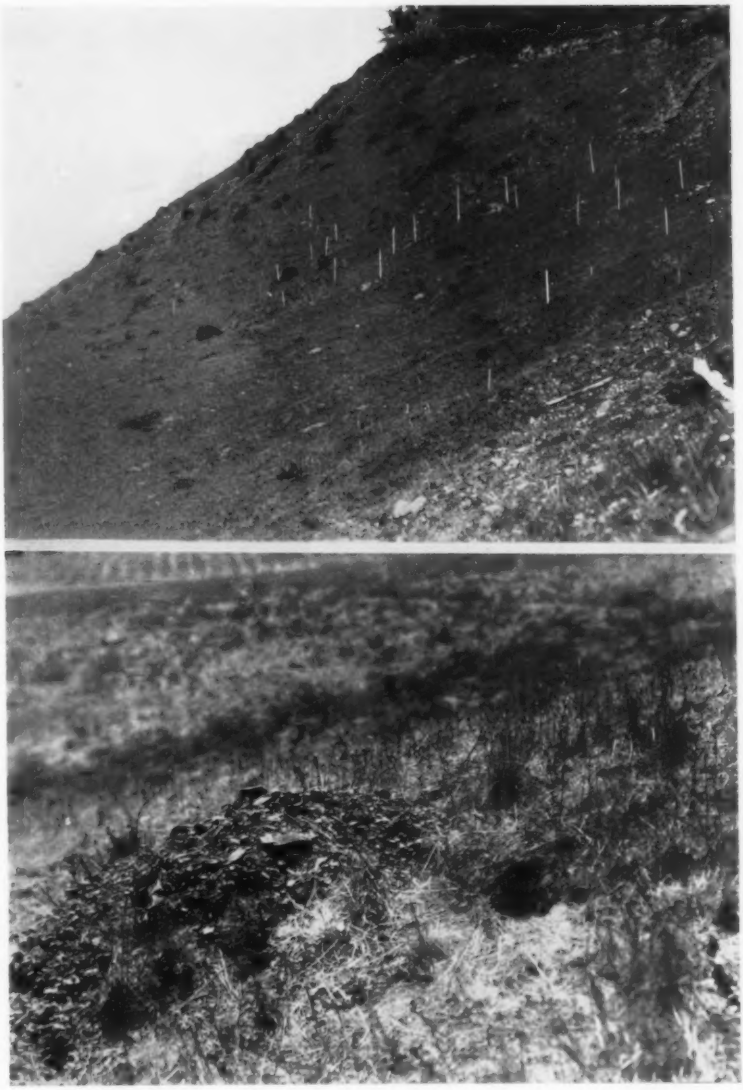
A typical burrow was dug out in a grainfield near Natron, Oregon. No squirrel was present, but as the season was getting late the occupant, seen there about two weeks previously, had probably moved or been killed. One of the nests appeared to have been quite recently occupied while the other was of some previous year for it was damp, moldy, and neglected. Much digging was sometimes necessary in order to excavate an extensive burrow system. At an abandoned gravel pit about five miles northeast of Eugene, Oregon, two burrow entrances, six feet apart on the face of a steep bank, ran into the bank about five feet. They were then connected by a main shaft that extended parallel to the face of the bank and continued in each direction to a total length of 12 feet. The average depth of this connecting shaft below the surface was 4 feet. Several blind or partly filled branches led off; four of these were on about the same level, while two went to higher levels, one to an old unused entrance on top of the bank. This system was in gravelly soil. Three abandoned nest cavities were found but no squirrel.

The majority of burrows were dug out during the fall and winter months. In only one burrow (Coburg Hills, February 28, 1930) was a squirrel found. This one was captured as she was digging at the upper end of her burrow in an effort to escape. The squirrel seemed rather dazed and sluggish as though she might have been in a light hibernation and had been aroused by the digging. Some squirrels may undergo a profound hibernation but most of them apparently retain enough consciousness to be disturbed by digging. Shaw (5) comments on this trait in connection with the Columbian ground squirrel which appears to undergo a more profound hibernation than the Douglas ground squirrel. That hibernation may not be continuous is indicated by the fact that a few squirrels even in the middle of winter appear above ground for an hour or so on warm sunny days.

The storing of food material in the burrow seems to be an irregular occurrence. There is really little need for storing food, for throughout most of western Oregon some food is available every month in the year. The storing habit persists, for in several burrows a considerable supply of oats and a few other seeds were found. Sprouted grain seeds were often found in abandoned nests. In one burrow oats packed in loose dry dirt were found in a little gallery leading off from the nest. Some of the food which requires husking is carried down into the nest, for oat hulls, lupine pods, and the like were sometimes found close to or in the nest. Probably most of the food is husked and eaten as gathered or at a husking station close to the entrance of the burrow. A considerable quantity of seeds can be carried in the relatively capacious cheek pouches. A large male that was kept in captivity could poke two unshelled peanuts into one pouch.

The amount of time spent by the squirrel in its burrow is large. Outside the burrow the animal is exposed to numerous enemies: man, hawks, coyotes, dogs, and stray cats. In its burrow it is relatively safe from these enemies. Its activities are strictly diurnal and then for only portions of the day. The census of animals seen during the course of the day in one locality would vary with the kind of day, the season, the availability of food, and the amount of persecution to which the animals had been subjected. During the summer not much more than half the day is spent above ground, which means that during its most active season the squirrel spends seventy-five per cent of its time in its burrow. During the winter the time spent in the burrow is very much longer.

The maximum number of squirrels for the year are in evidence the latter part of June, when the young are beginning to spend considerable time outside the burrow. After that time the population is cut down rather rapidly by the concentrated attention of hawks and other enemies on this easy source of food supply. Grinnell estimates the maximum life of the Beechey ground squirrel, a closely related form, to be about five years. Hall (4), quoting from Mitchell, mentions a *Citellus grammurus* that reached the age of nine



UPPER. A protected gully near Cape Blanco, Oregon. Stakes indicate burrow entrances.

LOWER. Debris dump in front of burrow entrance showing large amount of rock fragments brought up.

years and eleven months in the London Zoological Gardens. It is estimated that five or six years would be the maximum life span of the Douglas ground squirrel.

SUMMARY

1. Certain areas in Oregon favorably located with respect to availability of food, suitability for burrows, and freedom from disturbance by enemies support relatively dense populations of Douglas ground squirrels.

2. Sloping or well-drained pasture land with southern exposure is favored for burrow sites.

3. The burrow enters the ground at an angle of approximately 35 degrees for about two feet then levels off into a horizontal section about five feet long; this latter section contains a spherical nest-chamber and several branches, one or more of the branches serving as drains.

4. In long-established burrow sites a number of burrows may intercommunicate, and the system may contain a number of filled-in shafts.

5. Only one of the fourteen burrows excavated yielded a squirrel; this animal appeared to have been hibernating.

6. Food storage seems to be of irregular occurrence. Several of the burrows contained stored oats and other seeds.

7. The amount of time spent by the squirrel in the burrow is large; during the summer it averages about 75 per cent of the time, during the winter the percentage is very much higher.

8. Since the maximum age of closely related forms is about five years, it is believed that this would also hold good for the Douglas ground squirrel.

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A SUMMER BREEDING SEASON IN THE EASTERN CHIPMUNK, TAMIAS STRIATUS

By J. P. Schooley

Precise information on the breeding habits of *Tamias* is singularly meager[1,2] Seton (1909)[3] refers to the "mystery about the mating of the chipmunk" and cites a few instances of partly grown young being found from May 6 to late October. Howell (1929)[4] states that "The mating period of the eastern chipmunk is not definitely known but doubtless extends over a considerable period, beginning in the spring."

The factors producing a breeding season are not simple. There is evidence from embryological studies by the author to indicate that even though the chipmunks emerge and are active early in the spring, even ovulating and being inseminated, a period of unfavorable weather will cause cessation of mating activities and even the resorbtion of embryos already present. However, there is no doubt that there is a definite breeding season beginning as early in the spring as activity above ground can be undertaken. Mating activities began during the first week of April in Monroe County, Indiana, in 1932, a year of about average temperatures, but ovulations were not found until the last week of April.

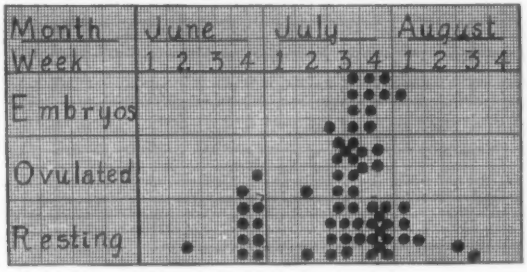
In addition to the spring breeding season, the chipmunks of northern Indiana have a definite cycle running through the latter half of July and the earlier part of August. Breeding is not continuous during the summer among these animals in that locality.

The data upon which this fact was established were accumulated incidentally to the collecting of early embryological stages. They do not extend in a specific way beyond the period when those stages occur. Besides the precise data plotted in the accompanying figure, field observations and records were made through the summers of 1929 to 1932, inclusive, while the writer was engaged at the Indiana University Biological Station at Winona Lake, Indiana, and during the winters of those years about Bloomington, Indiana. Many specimens have been taken which are not represented in the chart for the reason that complete data were not kept for them. However, certain facts pertaining to the specimens were noted so that in the latter summers no attempt was made to collect the animals for embryological purposes before July 15, because experience had shown them to be sexually inactive from the spring cycle up to that time.

Accurate measurements have been recorded for the animals collected during the last four summers mentioned above; both weights and measurements were recorded during the last two summers. From these figures and from observations on the mammary glands and ovaries it is clear that it is the old females that breed in the spring and that the younger ones, even those born the preceding spring and summer, are the ones that breed during the July cycle.

Old females that have not become pregnant from the spring mating may also breed at this time. The presence of old females pregnant at the spring mating season explains the large number of non-pregnant females taken during the peak of the summer breeding season. They represent about one-fourth of the non-pregnant animals taken at that time. They can usually be recognized by the presence of placental spots in the uteri.

Observations on the males also indicate a summer breeding season. In the chipmunk, as in many other mammals, the testes are withdrawn from the scrotum except at the breeding season. The state of activity of the glands themselves usually can be recognized macroscopically; being relatively small and flaccid during most of the year, but large, swollen and turgid at the time of rut. It is likely that most of the insemination of a



EXPLANATION OF THE FIGURE

Each dot on the figure represents an adult female chipmunk taken at the time indicated by its horizontal position and in a reproductive state represented by its vertical position. Resting here means that the animal has not ovulated recently and does not bear embryos although she may be suckling young. Ovulated means that the animal has shed ova recently but it does not specify whether mating has occurred or whether it be fertile or infertile. The term embryos here means those whose vesicles have produced uterine swellings visible by macroscopical examination.

given year is accomplished by males more than a year old, since not many year-old males were found to have scrotal testes during the breeding season.

There is a marked tendency for the males to emerge from hibernation earlier in the season than the females. This is true not only for *Tamias striatus*, but for all the burrowing forms that I have studied.[5] Early in the spring the entire catch of animals is likely to be males. This condition changes rapidly so that after about a week of favorable weather the proportion may be three males to one female. The ratio continues to shift until, after a large percentage of the females have ovulated, the balance may have shifted to one male to three females.

The cessation of activity of chipmunks in July noted by Seton and others is probably due to the summer breeding season. Activity has been measured

largely by the vocal expressions of these animals and my observations lead me to believe that the males are more active in this respect than the females. This is particularly noticeable during the breeding season, when the females are too busily engaged in providing food for their growing embryos to sing a great deal. Oftentimes during the latter part of the period of gestation such animals will not utter a sound even when escaping into their burrows; this is true also of suckling mothers. I attribute the "summer disappearance" to the relative inactivity of the males and to the industry of the females in foraging to provide for the oncoming generation. It is certain that there is no quantitative disappearance of these busy little rodents for any extended period in the territories where I have collected.

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HINTS ON LIVE TRAPPING

By Theophilus H. Scheffer

Trapping small animals alive in order to study them is not very difficult if one knows something of the trails and the tastes of the particular animal and its probable reactions to an intrusion into its ways of living. Simple devices for making the catch will suggest themselves, and the simpler in construction and the more easily available the parts, the better they will serve the purpose.

Everybody suggests pitfalls, so we tried them a number of times in varying arrangements and under varying conditions, for small rodents, moles, and shrews. Sometimes the pitfalls consisted of glass jars, or 5-gallon oil cans, with or without a tilting top; sometimes they were post-holes, lined or unlined, round or square. But it is inconvenient to carry these things around with you, particularly so in the case of the post-holes. And then if you are successful in making a good catch, the gray of the morning may reveal a carnage of the night in which the stronger have preyed upon the weaker until perhaps there are none left except a single overstuffed victor.

Small, easily portable traps are better than pitfalls for catching small mammals. And they need be only large enough in any case to accommodate a single animal, for even the best of rodent friends will often menace each other when trapped together. We want specimens alive and uninjured. To prevent the trapped animal from chilling, or to allay its fears by giving it a chance to hide, it is well to include a little dry grass combings or cotton in the back of the trap.

Spring-floor traps, baited well back and with bits of lure trailing to the outside, are quite efficient; the more so if the tripping device of the false floor can be adjusted to the weight of the animal. We have taken field mice, chipmunks, and ground squirrels at different times in the same trap, merely by shifting the sliding balance point.

The box part of such traps should be made of wire netting or sheet metal, of a size adapted to the "game." The tipping false-floor or perch may be a shingle or other light piece of wood, if you are prepared to supply a new one each time the original is partly consumed by a nervous rodent. We have seen three or four types of tipping-floor traps on the market, but each was rather high priced. The exception, a repeating affair mainly of wood, is used by some collectors, but it has the disadvantage of crowding its prisoners into a very limited, unsanitary space. Also it is edible, though designed for house mice. And it lacks accommodations for long-tailed species.

Our hat is off to the collector who first combined a five-cent mouse trap with an otherwise worthless bean can to form perhaps the best catchall for live animals of mouse size. For larger rodents, or those with long tails, a tomato can from the trash heap may be used and, if need be, this can be combined with a trap having a stronger spring. With an extension-trigger

substituted for the original bait hook or pan of the mouse trap, the bait may be placed farther back in the trap, in which case it is better to use a baking-powder can or other can with detachable lid. This will facilitate release of the prisoner, cleaning the trap, and rebaiting.

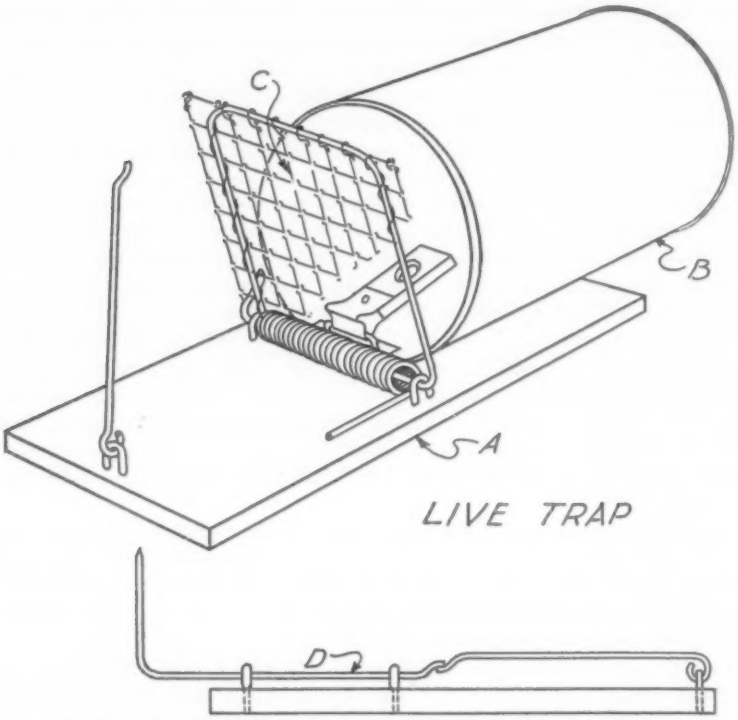


FIG. 1. Mouse trap combined with a small can to form perhaps the best catchall in the field for live animals of mouse size. A, Woodbase mouse trap. B, Small can from the trash heap. C, Quarter-inch mesh hardware cloth. D, Trap fitted with extension trigger, for use with baking-powder can. Lid of the latter may be replaced by a "No. 1, tall" trash can, for holding a nest.

For runway trapping, as in taking pocket gophers alive, we found it necessary to use the extension-trigger, to lure the animal farther back, and to have the door close inside the can or cylinder, instead of on the outside as in the live-mouse traps. This plan of trapping worked out successfully after much experimentation and final resort to baiting. For pocket gophers we now use a thick slice of sweet-potato or carrot, at least as large as a silver

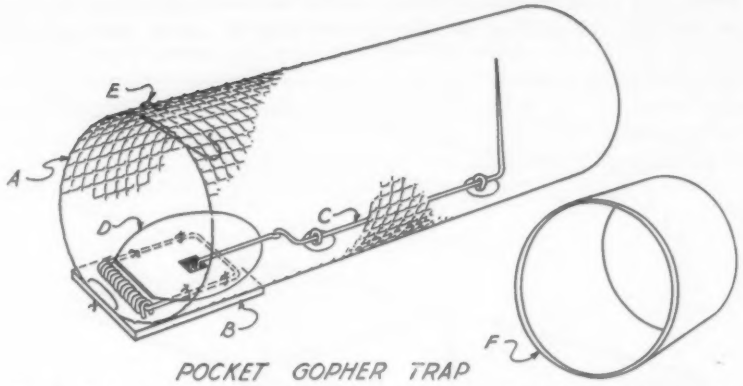


FIG. 2. For runway trapping we found it necessary to use the extension-trigger and to have the door close inside the trap. A, Trap body, of ½ inch mesh hardware cloth, 10 inches long. B, Wood-base mouse trap, sawed off in front, trigger shifted in position. C, Extension trigger, with 5 inch horizontal arm so placed as to facilitate baiting at back of trap; secured by small cotter pins and washer. D, Door, of black sheet metal, to sufficiently close the opening and lie as flat as possible when the trap is set. E, Stay-wire, to stop the door at vertical. F, Tomato can, to slip over back of trap after baiting. This trap is to be set spring side up.

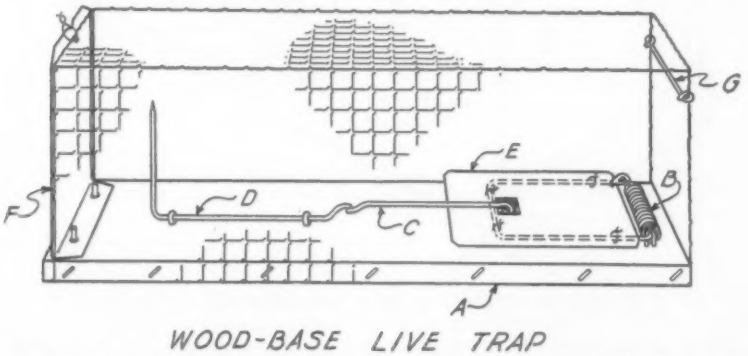
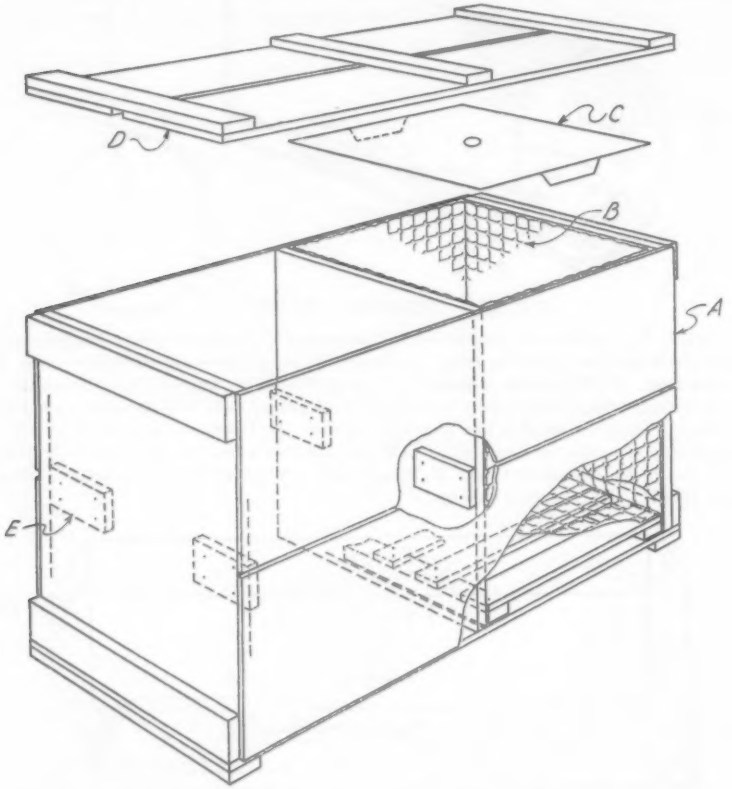


FIG. 3. A trap suitable for moderate sized rodents, or other small animals, is easily made of hardware cloth, with base of plywood. This model is 4 inches square and a foot long; sheet of netting used, 12 x 12 inches. By using a sheet 12 x 16½ inches the netting can be lapped over the ply-wood base to protect it from gnawing. The trap is to be set wood base up. A, Ply-wood base, to which a mouse-trap spring, trigger, and extension trigger are attached by small cotter pins; netting stapled to base. B, Trap spring. C, Trap trigger. D, Extension trigger. E, Door of black sheet-metal. F, Exit, or removable rear gate, of same material. G, Door stop.

dollar, with broad side to the front so that it will serve either as a lure or as an obstacle. In making the body of this trap we use a hardware cloth



LABORATORY AND SHIPPING CAGE

FIG. 4. A convenient cage for the smaller rodents when kept alive for study purposes or for shipment is made from a standard egg-case, with hardware cloth fillers for each of the two compartments. A, Egg-case. B, Single filler unit for one compartment, suitable for shipping animals as large as a cottontail rabbit. C, Black sheet metal lid for this unit. D, cover of egg-case. E, Cleats for supporting lath rack when smaller units are used above and below. Spaces between boards at sides, top, and bottom of crate will insure sufficient ventilation.

cylinder, with a discarded tomato can to close the open end opposite the door This trap will, of course, face but one way, and should be set with the front

end just inside the burrow entrance. Then cover the whole with green vegetation that may be attractive to the pocket gopher, or, if such is not available, partly darken the trap with trash and earth.

A trap suitable for some of the moderate-sized rodents, as chipmunks and ground squirrels, is easily made of hardware cloth with a light, strong base of ply-wood. Arrangement of parts is similar to that in the pocket gopher trap, except that the body is rectangular in outline and the rear opening is closed by a sheet metal gate instead of a tomato can.

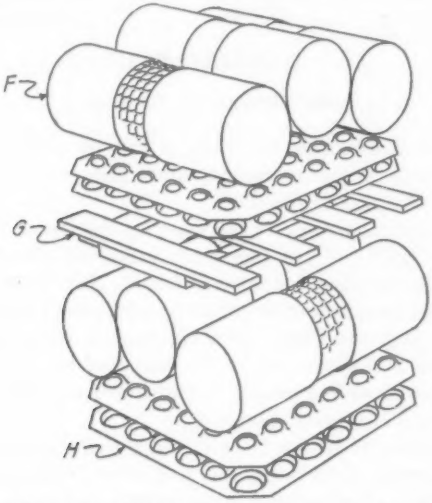


FIG. 5. Six such units, mouse size (F), or four units, gopher size, will be contained in each compartment of the egg-case shipping cage, with a slatted rack (G) between the upper and lower tiers of cans and packing of paper egg-case "flats" (H) under each tier. The rack is to rest on small cleats. The lower tier of units is laid lengthwise of the case, the upper tier crosswise, for better ventilation.

In connection with handling and transporting small, live animals, we have found an ordinary commercial egg-case to be extremely useful. A removable filler unit or cage of hardware cloth with sheet metal cover may be used in each compartment of the case for rodents the size of a cottontail rabbit. For smaller rodents, especially when they must be segregated, a very convenient and satisfactory filler unit is made of a hardware cloth cylinder eleven inches long, each end closed by a loose fitting tomato can for rodents of mouse size, or a one-pound coffee can for gophers and the like. Each compartment of the egg-case will accommodate six of the mouse units or four of the gopher units with space for ventilation and the use of absorbent

packing. One end of each filler unit should contain a cotton nest, the other a food supply.

To avoid mussiness and general unsanitary conditions in a cage or shipping crate, remember that it is not necessary to provide the rodents with a dish of water if they have succulent food. This is true of all rodents from mice to beavers.

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MARKING BATS

By Donald R. Griffin

Considering its possibilities, the study of bats by marking individuals has received rather little attention from mammalogists, and I know of only four published references to the subject.

The first and in many respects the most interesting of these is Dr. A. A. Allen's account (1921) of banding with numbered aluminum bird bands several *Pipistrellus subflavus subflavus* at Ithaca, New York. In the summer of 1916, Dr. Allen banded four pregnant females which roosted in the corner of a porch roof and recaptured three of them in June, 1919, in the same place. Dr. Allen also discovered in the course of his banding experiments that another small breeding colony of pipistrelles remained together in one roosting place for more than a month.

A. Brazier Howell and Luther Little (1924) record the recapture on June 16, 1923, of two banded *Eptesicus fuscus* in Covina, California. These bats, together with three others of the same species, had been captured at this same roost on July 20, 1921, and were banded and released at Pasadena, California, about twenty miles away.

E. L. Poole (1932) states that a large number of *Myotis lucifugus lucifugus* and a few *Myotis keenii septentrionalis* and *Pipistrellus subflavus subflavus* were marked and released at varying distances from the caves in Berks County, Pennsylvania, where they had been caught. Several were recaptured a few days later in their home caves, and it was thus proved that some of the *Myotis keenii* and the *Pipistrellus* returned from as far as 18 miles. A few of the *Myotis lucifugus* returned from as great a distance as 27 miles.

Another reference to work along these lines is found in Dr. Charles A. R. Campbell's book "Bats, Mosquitos and Dollars." Dr. Campbell writes that he marked over 2000 *Tadarida mexicana* near San Antonio, Texas. His experiments, as recorded in his book, indicate that this bat also shows a homing instinct.

During the summers of 1932 and 1933 I had an opportunity to study a

colony of *Myotis lucifugus lucifugus* located in an unoccupied house near Hatchville, Cape Cod, Massachusetts, and I experimented with two methods of marking these bats: tattooing numbers on the wing membranes, and banding with numbered aluminum bird bands. This paper records some of the preliminary data obtained, and, although only a limited amount of time could be devoted to the work, enough was accomplished to show that the methods used were entirely practical and that further studies would undoubtedly produce very interesting results. I wish to express my gratitude to Dr. Glover M. Allen, of the Museum of Comparative Zoology, for assistance rendered in numerous ways.

HABITAT AND MEANS OF CAPTURE

The small frame house in which the bats roosted had not been inhabited for several years, and its dilapidated condition makes it an ideal retreat for

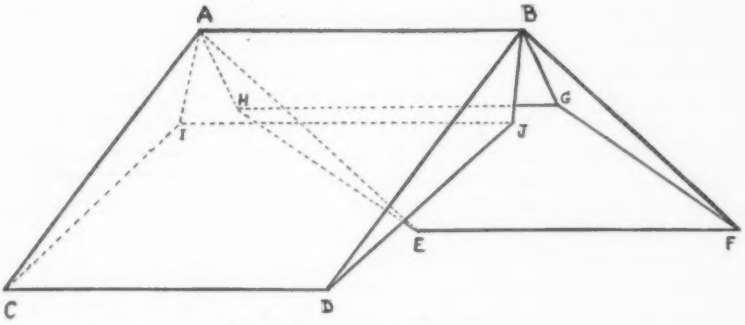

FIG. 1 "TRAP-ROOST" FOR BATS

bats. It stands in a clearing in mixed woods and is not far from several cranberry bogs and a rather large pond. The bats apparently first arrived about the middle of May, and I never observed any after the early part of September. The great majority of the adults were females, and the young were probably born in early June. The bats seemed to be most numerous in the latter part of June and early in July.

The garret of the house where they roosted had never been plastered, and the roof boards, which met in a ridge about eight feet above the garret floor, were loosely fitted and in many places were rotted and decayed. Usually the bats spent the daytime in the small crevices between the sheathing and the rotten rafters, but often, especially on warm afternoons, they would hang in clusters from the ridge of the roof on the inside. I never saw more than about 100 bats hanging thus from the ridge, but the total number of bats in the colony was probably greater than the size of the clusters in the open garret would indicate. For most of the bats seemed to spend the daytime

in the numberless cracks and crevices which the decaying framework offered; and, considering how small a space a bat can squeeze into, there was no way of estimating how many could find shelter in the various parts of the old house.

When the bats were hanging in clusters from the garret roof they could be captured with a net, but it was difficult to take many in this way, because when disturbed they either flew off or else crawled hurriedly into the inaccessible crevices between the boards. In order to catch them in larger quantities than was possible with a net alone, a "trap roost" was placed at the ridge of the roost on the inside. Since this trap roost proved very useful in capturing bats in quantities, I am including a description and diagram of it.

As shown in the figure, the trap roost consists of two wooden pockets, AlCDJB and AHEFGB, which are hinged together along AB. Both of these pockets are entirely closed in, except for the openings at the top, AIJB and AHGB; and when the two pockets are swung together (that is, so that IJ and HG coincide) both these openings will be closed.

When in use the trap roost is fastened to the inside of the garret roof so that AB lies along the ridge of the roof and the faces ACDB and AEFB are swung out and fastened against the two sloping sides of the roof. Then the bats hang along the ridge of the roof, both within and beyond the trap roost, and when the two pockets are quickly swung together the bats within cannot escape. The trap roost can then be taken down and the bats removed at leisure. In order to facilitate getting the bats out of the pockets, the edges CD and EF are also hinged so that the faces CIJD and EHGF can be swung open if necessary to remove the bats.

This trap roost proved to be highly successful. The bats would often hang from the roof ridge inside of it and when disturbed would retreat into the pockets instead of into the cracks between the boards of the building. By this means I was able to capture many more bats than would otherwise have been possible. On one occasion 65 were taken from this trap roost, which was only 16 inches long and 15 inches deep.

MARKING

During the summer of 1932, when I first began to mark bats, I tattooed numbers on the wing membranes. A five-pointed tattooing needle and black tattoo ink designed for marking rabbits were used, and the numbers thus formed were easily discernible when the out-stretched wing of the bat was held up so that the light came through the semi-transparent membrane.

Tattooing, however, proved to be an unsatisfactory method, and I decided that aluminum bird bands would be more suitable. In the first place, considerably more time and trouble are required to mark a bat by tattooing than by banding, since the tattooed number must be laboriously pricked in with a needle while a band can be closed around a bat's leg in a few seconds. Also a close examination is required to determine whether a bat is tattooed,

whereas a band is plainly visible and can be quickly read. But the greatest disadvantage of tattooing, as compared with banding, is that only a number can be tattooed on a bat's wing, while a band can also bear a return address so that if the bat should afterwards be found the bander would be notified.

Accordingly I obtained permission from the U. S. Biological Survey to use some surplus No. 0 bird bands, which are stamped on the inside "Notify Biol. Surv. Wash. D. C." In each case the band was placed around the bat's tibia. Thus the band fitted snugly and was in no danger of becoming loose.

Twenty-nine bats were tattooed in 1932, between June 29 and August 30, and one was banded on September 7. Twenty-two of these were liberated at the roost in Hatchville, and, in an effort to discover whether the bats showed any homing instincts, five were released at Barnstable, about ten miles in an air line from the old house in Hatchville; and two others were set free at North Eastham, 34 miles from the roost. During 1932, although bats were caught on eight different days, no bat that had been marked before was recaptured.

In 1933 the banding was continued. Largely by means of the trap roosts described above many more were caught, and between May 14 and August 13, 131 were banded. Three of these were liberated at Barnstable, while the rest were released at the roost in Hatchville.

In 1933 two bats were caught which showed clearly numbers tattooed the year before. One of these "returns," to borrow a word from the terminology of bird banding, tattooed no. 33, had been liberated on August 31, 1932, at North Eastham, and was recaptured on July 22, 1933 at the roost in Hatchville. The other, tattooed no. 32, was marked on August 11, 1932, and liberated at the roost; it was recaptured at the same place on August 13, 1933. Both of these bats were banded at the time of recapture. Also one bat, No. h40004, banded May 23, 1933, was recaptured on August 13, 1933.

Thus at least two of the thirty bats marked in 1932 returned to the roost the next season, and one of them found its way back although it had been liberated at North Eastham, 34 miles away.

In view of the fact that in all 161 bats were marked, it is surprising that there were so few recaptures. This might possibly have been because handling and marking frightened the bats so that they either deserted the roost or else did not so readily permit themselves to be recaptured. Certainly the process of marking could not have injured them, as I have kept both tattooed and banded bats in captivity for two or three days without ever seeing any signs that they were at all inconvenienced by their markings.

However, when the trap roosts described above have been perfected, it should be possible to capture and band a larger proportion of the bats in the colony and thus obtain more complete data on their movements.

DISCUSSION

In general it may be said that the few scattered efforts that have been made to mark bats have proved conclusively that *Pipistrellus*, *Eptesicus*, and *Myotis* return in successive seasons to the same summer roosts, from which they are entirely absent in winter, and that these species, and also probably *Tadarida mexicana*, show a marked homing instinct and will return to their "home" roosts although released many miles away.

In addition, Dr. Allen's experiments with *Pipistrellus* indicate that small groups of this species tend to remain together for considerable periods. Also, we have data on the age which the individual bat attains. Banded *Pipistrellus* and *Eptesicus* have been recaptured after three and two year intervals, respectively, and as the bats in both cases were adults when banded these may be considered longevity records of four years for *Pipistrellus* and three years for *Eptesicus*. *Myotis* has not been studied in this way long enough to afford any data of this kind.

However, in reviewing the efforts that have been made to mark bats, one fact is particularly striking. To date only the more sedentary species, the so-called "cave bats," which are known to hibernate, have received attention, while the so-called "tree bats," *Lasiurus borealis*, *Lasiurus cinereus*, and *Lasionycteris noctivagans*, which are undoubtedly more migratory, have not been studied in this way at all. This, of course, is because bats such as *Myotis*, *Eptesicus*, and *Pipistrellus* are highly gregarious and assemble at times in large groups, and can then be readily captured in numbers. But the tree bats, although they perform long migrations, are solitary in their habits and therefore difficult to catch in quantities. Although often shot on the wing, these bats are only rarely obtained alive, as when some lucky mammalogist chances on one hanging in a tree.

However, it has already been shown (Van Tyne, 1933; Storrs, 1926; Jackson, 1926) that bats can be caught in nets of various kinds, and the perfecting of such methods should make it possible to capture and band bats of any species.

This outline of the record of bat-marking to date certainly suggests that there are interesting possibilities for further development of the work. In view of the interesting results obtained by bird banding, and the proof that similar methods can be successfully applied to bats, it is surely desirable that mammalogists who have the opportunity should devote some attention to the banding of bats.

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Barnstable, Mass.

A PHYLOGENETIC CHART OF THE ARTIODACTYLA

BY W. D. MATTHEW

[With a foreword and comments by EDWIN H. COLBERT]

At the time of his death, the late Dr. William Diller Matthew left unfinished a phylogenetic diagram of the artiodactyl ungulates, which he had undoubtedly intended to publish as the subject of a short paper. He had drawn up a rough outline to serve as a guide for the drafting of a finished chart, but unfortunately he was never able to bring this chart to completion, nor did he leave any explanatory text. The rough diagram prepared by Dr. Matthew has recently come to light, together with the chart as it had been carried to partial completion under his direction. It has been thought advisable to have this chart finished and published, to serve as an expression of Dr. Matthew's views on the evolution of the Artiodactyla. The drafting has been finished by Margaret Matthew Colbert.

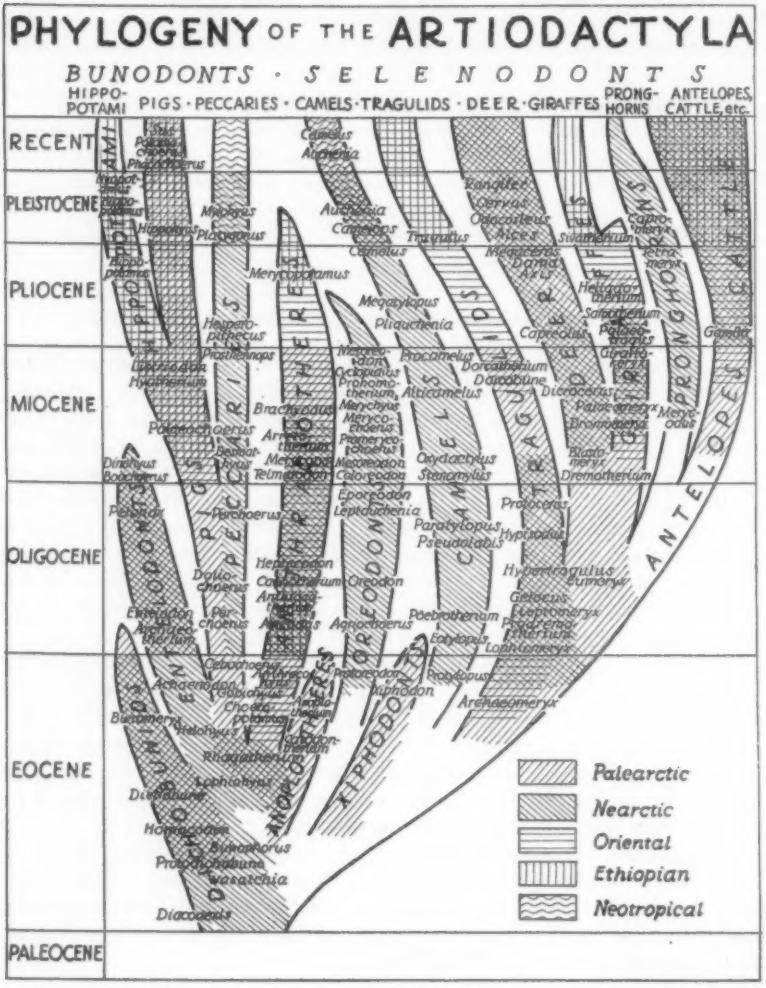
The chart as now published, demonstrating the phylogeny of the Artiodactyla, was probably formulated late in 1929 or early in 1930, and it represents the summing up of Dr. Matthew's extraordinarily complete knowledge of the Artiodactyla, a group to which he had devoted many years of study. It was prepared as a graphic and a phylogenetic expression of his classification of the Artiodactyla which appeared in 1929,[1] and as such it should be considered as supplementary to this earlier paper.

The diagram has been completed just as Dr. Matthew had outlined it, in order that it might remain entirely free from editorial bias. Therefore it may be well to make a few comments in explanation of certain seeming inconsistencies that Dr. Matthew would undoubtedly have corrected had he lived to bring his work to completion.

[1] Matthew, W. D. 1929. 'Reclassification of the Artiodactyl families.' Bull. Geol. Soc. Amer., vol. 40, pp. 403–408.

COMMENTS

1. The genera listed in the chart are representative of typical forms living at various times, and naturally are not intended as a complete list of all of



the fossil and recent artiodactyls. The sequence of genera shown on the chart in no way represents lines of phylogenetic or structural evolution.

2. Certain typical genera (e.g. *Hippopotamus, Tayassu, Tragulus, Cervus, Giraffa, Okapia, Antilocapra, Bos,* etc.) are omitted from the space reserved for recent forms, probably because they are so obvious as to need no mention.

3. With the exception of *Gazella,* no genera are listed on the phylogenetic branch representative of the Bovidae. This family is so large and complex that Dr. Matthew probably thought best to treat it in the simplest way possible.

4. On the chart, *Caenotherium* is included with the anthracotheres, whereas in Matthew's 1929 paper the Caenotheriidae and the Anthracotheriidae were listed as separate families. This discrepancy may have been due to an oversight which later would have been corrected, since the name *Caenotherium* is penciled in on the original copy, as if it had been added as an afterthought.

5. In the classification of 1929 there is a family Amphimeryicidae, which is omitted on the accompanying chart.

6. The close approximation of the deer and the giraffes is somewhat at variance with Dr. Matthew's earlier work, but a penciled query on the original copy may mean that he considered this arrangement as more or less subject to question.

7. Certain symbols representative of distribution are omitted, probably oversights that would have been corrected on the final chart. These are:

a. Palaearctic for the hippopotami in the Pleistocene.

b. Oriental for the deer in the Pliocene, Pleistocene, and Recent; Neotropical for the deer in the Pleistocene and Recent.

The American Museum of Natural History, New York, N. Y.

SYSTEMATIC REVIEW OF THE CALIFORNICUS GROUP OF THE RODENT GENUS PEROMYSCUS

By Joseph Grinnell and Robert T. Orr

Peromyscus californicus is the largest member of its genus occurring in the United States. At the same time, it is remarkably restricted in its general range—to California south of San Francisco Bay and west of the deserts, and to extreme northwestern Lower California. (See maps, figs. 1, 2.) On islands in the Gulf of California there are some forms of doubtfully near affinities; these are not considered in this paper.

Peromyscus californicus is so closely confined to the Upper Sonoran Zone that it may well be cited as an "indicator" of that zone. Where populations are found locally amid Transition surroundings, or, more rarely, amid Lower Sonoran surroundings, the localities are always closely adjacent to the Upper Sonoran.

This animal therefore belongs to the "Californian Fauna," characterized by the presence of such other mammals and birds as *Dipodomys agilis*, *Perognathus californicus*, *Neotoma fuscipes*, *Sylvilagus bachmani*, wren-tit, and California thrasher. Its habitat predilections are further attuned to the conditions provided in the belts of true chaparral, with whose long evolutionary history its own origin must have been intimately involved.

Whereas Osgood (1909, pp. 234–238) gave only two subspecies of *Peromyscus californicus*, we now recognize five, with ranges as outlined on the accompanying maps (figs. 1, 2). These maps show a remarkable concordance, especially to the southwards, when compared with a map of the distribution of the *Neotoma fuscipes* group of wood rats (see Goldman, 1910, p. 88, fig. 13). To the north the parallel ceases, in that the wood rats continue while the "parasitic" white-footed mice stop short at about 38° latitude. The idea long ago expressed that the kind of mouse in question must be in some way closely dependent on the house-building wood rats is not altogether supported when we note that the rats occur in seemingly maximum numbers (quite continuously, save at the Golden Gate and San Francisco Bay) far beyond the known limits of the mice. Also the notebook trapping records which we have taken pains to review show many instances where, locally, mice of this group have been taken too far from any wood-rat houses to make it probable that these were their headquarters.

Using Osgood's general revision as standard for the other Californian species in the genus *Peromyscus*, it is to be noted that over the same area as covered by the distribution of *californicus*, with its now recognized five subspecies, there are three subspecies of *truei*, two subspecies of *boylii* and but one of *maniculatus*. This is in direct order of size of the species—from which it might be deduced that the larger the animal the more responsive it is to those influences which make for racial differentiation.

But looking again at the maps of general range of these several species, we see that, in California, *maniculatus* is most extensively and continuously distributed, *boylii* and *truei* next, and *californicus* least; that is, there is apparently an inverse correlation of size (see table 1) with extent and continuity of range—the larger the animal (in *Peromyscus*) the more restricted is it in general geographic distribution.

Putting these correlations together we can say that (for *Peromyscus*) increased size of the animal seems to limit the free streaming movement of populations and this makes for heritable modifications—permits specializations. That increased size could bring restriction in rate of general population movement may seem an inconsistency; but nevertheless search reveals examples in many other genera of vertebrates; indeed, exceptions to this possible rule seem few.

In casting about for a possible cause of this phenomenon, we are inclined to eliminate food supply; for *Peromyscus*, of whatever species, judging from trapping experience, is notably omnivorous for a rodent. We also eliminate

TABLE 1

Average weights in grams of Californian species of Peromyscus from lower western slope of southern Sierra Nevada

	NUMBER AVERAGED		MALES	FEMALES
P. maniculatus	20♂♂	18♀♀	21.0	22.1
P. boylii boylii	20♂♂	20♀♀	25.9	27.1
P. truei gilberti	14♂♂	7♀♀	29.1	31.9
P. californicus mariposae	3♂♂	2♀♀	47.6	43.8

cover in a general sense, as comprising any sort of vegetation or other concealing agency when the animals are foraging abroad. It is to be recalled that *Peromyscus* is distinctly nocturnal in its activities, and further that it is not an efficient burrower. *Peromyscus* is dependent for daytime safety, for refuges when assailed by enemies, for breeding dens, upon crevices or "hideyholes" already afforded by a locality or at least available with relatively little excavation or modification.

We are led to believe, therefore, that the critical factor is the presence in a neighborhood of accessible crevices or holes of a size and extent that meet the physical necessities imposed by the size of the mouse, as also by its instinctive needs for places of shelter. In the latter regard a given hole may be too large to be "comfortable"—quite as prohibitive a feature as if it were too small to admit freely the body of the animal. We may reasonably postulate that any given locality will afford no hole beyond a certain caliber; that different localities will vary in size of maximum caliber of holes furnished; that all localities will furnish more, and more evenly distributed, holes or crevices of small size than of large size.

Taking it by and large, therefore, the small-gauged mouse will find shelter suited to its requirements for existence more continuously and farther than

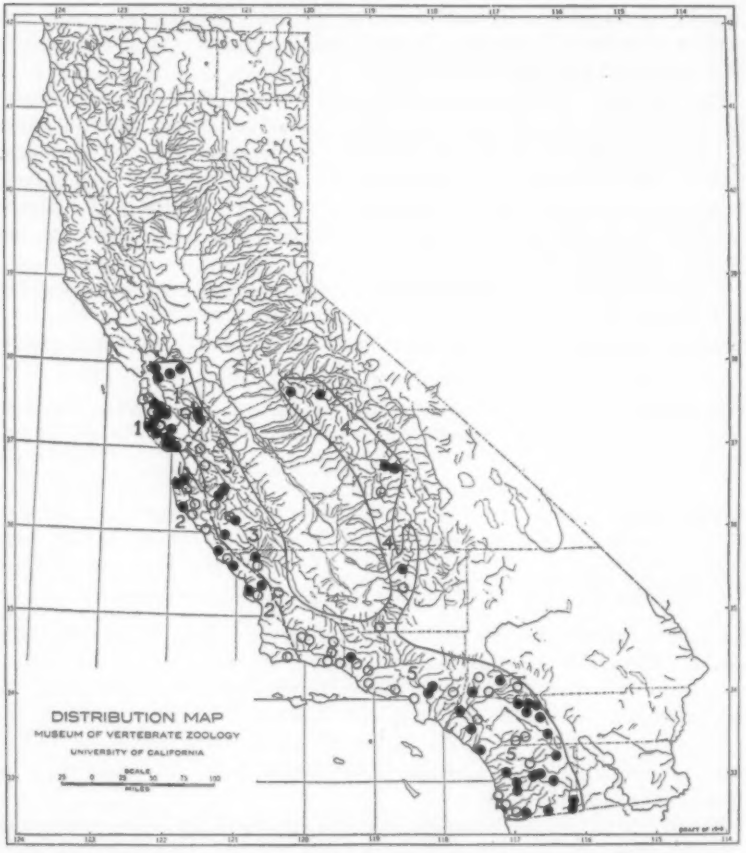


FIG. 1. Stations of occurrence of *Peromyscus californicus*, including its five subspecies, in California. Solid circles mark localities whence specimens have been examined by the authors of the present paper; open circles mark stations of record otherwise. Assumed general range outlined; but it is not to be inferred that the species exists continuously over all the included area.

a larger-gauged mouse. And we find, just as above set forth, that *Peromyscus maniculatus gambelii* is more continuously and extensively distributed than *P. boylii, boylii* than *P. truei*, and *truei* than *P. californicus*. The

latter is dependent upon the availability, in sufficient frequency for a persisting population of its own kind, of larger-sized crevices, spaces, or holes excavated by other animals, in or under logs, deadfalls, leaf-litter on canyon walls, or houses of wood rats. Such larger-sized spaces failing, this large-sized *Peromyscus* is unable to persist. A belt of sparse chaparral, or open, unforested terrain, or ground unoccupied by burrowing animals of proper caliber, becomes to it more generally a barrier to further dissemination of its kind than to a smaller species of *Peromyscus*.

Despite the greater capacity of a large-sized *Peromyscus* to indulge in far-flung nightly excursions, this increase of "cruising radius" does not suffice to bridge the greater spaces where no large-sized hidey-holes are provided. Thus we have, paradoxically, the larger-sized species more subject to isolation of segments of its general population, with changing environmental conditions, than the smaller species—and with more recognizable subspecies as a result.

In the following characterizations of subspecies the comparative method has been employed for the most part, because full descriptions of the species and two of its subspecies have already been given (Osgood, 1909). Our measurements conform to those of Osgood, with one exception: the interparietal length and width were not used by us because of the difficulty we met in obtaining accurate readings. In most cases we purposely omitted dimensions of ear because of the ambiguity of the figures on the labels of our specimens. With very few exceptions, all specimens used for our averages of measurements were old adults, as seen by well-worn teeth; in no case was a specimen used whose teeth did not show some indication of wear.

Peromyscus californicus parasiticus (Baird)

Parasitic White-footed Mouse

[*Hesperomys*] *parasiticus* Baird [*ex* Cooper, MS], Mamm. North Amer., p. 479, in text, 1857.

Type locality.—"Santa Clara valley" [probably near Mountain View], Santa Clara Co., California. *Lectotype*, in U. S. National Mus.; here designated as the first of the two specimens listed by Baird, namely, no. 1156, ♂, "Santa Clara, Cal. Nov. 1855 Dr. J. G. Cooper." This was a "dry skin," and seven measurements are given, in inches and hundredths. These transposed to millimeters are as follows: "Nose to occip.", 34.3; "nose to tail", 116.8; "tail to end of vert.", 120.7; "tail to end of hairs", 121.9; "length of fore foot", 13.2; "length of hind foot", 26.7; "height of ear", 19.1.

Since writing the above we have made enquiry as to the existence of the above specimen in the United States National Museum. Dr. Remington Kellogg writes us that both the specimens listed by Baird (1857, p. 479, in table) prove to be there. He says: No. 1156 "is recorded in the catalogue as a dry skin; it has been mounted and has been in one of our exhibition cases for a great many years. It is our intention now to remove it from the exhibition case and place it in the type case." No. 1157, with data as indicated by Baird, is "recorded as a skin; this can not now be found. No. 2039 is a skull that belonged with this skin; this skull, broken in two or more pieces, has been located."

Peromyscus californicus californicus (Gambel)

Monterey White-footed Mouse

Mus californicus Gambel, Proc. Acad. Nat. Sci. Philadelphia, vol. 4, p. 78, August, 1848. *Peromyscus californicus* Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1895, p. 34. February 21, 1895.

Type.—Lost; collected by William Gambel "in a field near Monterey", Monterey County, California, probably about 1842.

Geographic range.—The coastal strip of west-central California, from vicinity of Monterey south to (presumptively) northwestern Santa Barbara County. This area lies altogether west of the Salinas Valley and for the most part within the fog-belt. (See map, fig. 1, No. 2.)

Diagnosis.—Size large. General coloration dark, but averaging appreciably paler than in *P. c. parasiticus;* pectoral spot usually well pronounced, but underparts less suffused with dusky than in *parasiticus.* Skull, moderately large, intermediate in size between that of *parasiticus* and that of *P. c. benitoensis;* rostrum long and slender; braincase narrow; dentition heavy.

Measurements.—Average and extreme measurements in millimeters of a series of seven adults (3 ♂♂, 4 ♀♀) from Monterey and San Luis Obispo counties are as follows: total length, 245.3 (235–266); tail vertebrae, 131.6 (122–140); hind foot, 26.3 (25–29); greatest length of skull, 30.0 (29.1–30.6); basilar length, 23.3 (22.6–23.8); zygomatic width, 15.1 (14.7–15.9); interorbital constriction, 4.7 (4.5–4.8); length of nasals, 11.3 (10.6–11.8); shelf of bony palate, 4.6 (4.1–4.9); length of palatine slits, 6.2 (5.9–6.5); diastema, 7.7 (7.4–8.3); postpalatal length, 11.1 (10.7–11.4); maxillary toothrow, 4.5 (4.4–4.6).

Specimens examined.—A total of 52, representing the following localities in the coastal district of south-central California: Monterey County: Monterey, 11; Seaside, 5; Big Sur River, 1. San Luis Obispo County: San Carpojo [Carpoforo] Creek, 7 miles north of Piedras Blancas, 12; Cambria, 1; Santa Margarita, 19; vicinity of Morro, 3.

Remarks.—The race *P. c. californicus,* while having a rather long range from north to south, is yet quite constant in color and size throughout. It is limited to a notably narrow strip along the coast; representatives of the species from Jolon, Monterey County, just over on the east side of the Santa Lucia Mountains, are distinctly members of the race *benitoensis.* In the authors' present estimation, specimens of the species from Ventura and Los Angeles counties are best referred to *P. c. insignis,* which race they approach closest both in coloration and in measurements; and they are so listed.

Peromyscus californicus benitoensis, new subspecies

San Benito White-footed Mouse

Type.—Adult female, skin and skull; no. 28197, Mus. Vert. Zool.; 1300 feet altitude, near Cook Post Office, Bear Valley, San Benito County, California; collected by Richard Hunt, July 12, 1918; orig. no. 634.

Geographic range.—The Salinas Valley and inner Coast Ranges of west-central California, from and including San Benito County south at least to San Luis Obispo County. (See map, fig. 1, No. 3.)

Diagnosis.—Size, somewhat intermediate between that of *P. c. californicus* and that of *P. c. insignis* but with tail proportionately shorter than in either. Color, paler above than in *californicus;* pectoral spot usually absent; terminal band of white on hairs of underside longer than in *californicus;* in worn pelage resembling *insignis* in pale coloration. Skull, intermediate in some respects between that of *californicus* and that of *insignis,* but with greater interorbital breadth, longer palatal bridge, and larger audital bullae than in either of these races.

Measurements.—Average and extreme measurements in millimeters of ten adults (6♂♂, 4♀♀) from western San Benito and eastern Monterey counties are as follows: total length, 243.2 (232–260); tail vertebrae, 129.9 (120–140); hind foot, 26.3 (25–28); ear, 21.9 (20–25); greatest length of skull (average of 9), 29.7 (28.6–31.2); basilar length, 23.0 (21.7–24.4); zygomatic width, 15.2 (14.6–15.8); interorbital constriction 4.8 (4.6–5.0); length nasals 10.9 (10.2–11.5); shelf of bony palate, 4.7 (4.4–4.9); length palatine slits, 6.2 (5.7–6.7); diastema, 7.7 (7.2–8.2); postpalatal length, 11.1 (10.2–11.7); maxillary toothrow, 4.6 (4.5–4.8).

Average weight of 9 adults (6♂♂, 3♀♀), 42.8 grams.

Specimens examined.—A total of 26 representing the following localities in California: San Benito County: Cook, 1300 feet, Bear Valley, 11. Monterey County: Jolon, 2; Stonewall Creek, near Soledad, 3; San Lucas, 5. San Luis Obispo County: two miles south of San Miguel, 4.

Remarks.—*Peromyscus californicus benitoensis* is a pale-colored inland race, inhabiting the somewhat arid interior portions of south-central California west of the San Joaquin Valley. Its range lies parallel to that of *P. c. californicus*, which latter race occupies the adjacent, outer coastal strip to the westward. Intergradation takes place between these two forms at the mouth of the Salinas Valley, as seen by specimens from Seaside, Monterey County, and north along the Mount Hamilton Range. Geography would make it seem probable that the specimens from near Fort Tejon, Kern County, referred by Osgood (1909, p. 237) to *californicus* are intermediate between this race and *P. c. insignis*.

Considering the near relationships between *benitoensis* and the three other races with which it comes into geographic contact, the following comparisons are offered:

As contrasted with *P. c. parasiticus*, *benitoensis* has smaller size and paler coloration, with pectoral spot much reduced or absent; tail much shorter; skull smaller, with much shortened rostrum; brain-case shorter and proportionately broader; anterior palatine foramina shorter.

P. c. benitoensis differs from *P. c. californicus* in paler coloration, smaller size and shorter tail; cranially it shows smaller size, greater interorbital breadth, longer palatal bridge, and larger audital bullae.

Compared with *P. c. insignis*, *benitoensis* is larger, with shorter tail, relatively broader brain-case and larger audital bullae.

Peromyscus californicus mariposae, new subspecies

Mariposa White-footed Mouse

Type.—Adult male, skin and skull; no. 21703, Mus. Vert. Zool.; El Portal, 2500 feet altitude, Mariposa County, California; collected by Walter P. Taylor, December 1, 1914; original no. 7159.

Geographic range.—The lower western slopes of the southern Sierra Nevada, south at least from northwestern Mariposa County to Kern County. (See map, fig. 1, No. 4.)

Diagnosis.—Size rather large. Color in general, intermediate between that of *P. c. californicus* and that of *P. c. insignis*, but with black wash more pronounced over back than in either of these two forms; underparts whiter than in any other race of this species; pectoral spot entirely lacking in all specimens examined. Skull moderately large, with relatively short, broad rostrum; zygomata widely expanded; anterior palatine foramina broad; brain-case broad; audital bullae large.

Measurements.—Average and extreme measurements in millimeters of a series of seven adults (4♂♂, 3♀♀) from Mariposa and Fresno counties are as follows: total length, 245.4 (231–258); tail vertebrae, 128.7 (117–135); hind foot, 26.9 (25–28); greatest length of skull (average of 6), 30.1 (29.7–30.4); basilar length, 23.5 (23.1–23.9); zygomatic

width, 15.5 (15–15.9); interorbital constriction, 5.0 (4.7–5.1); length nasals, 11.3 (10.7–11.6); shelf of bony palate, 4.6 (4.2–5.0); length palatine slits, 6.4 (6.1–6.6); diastema, 7.9 (7.7–8); postpalatal length, 11.4 (10.9–11.7); maxillary toothrow, 4.5 (4.2–4.8).

Average weight of five adults (3♂♂, 2♀♀), 46.1 grams.

Specimens examined.—A total of 10, representing the following localities in California: Mariposa County: Pleasant Valley, 600 feet altitude, 1; near El Portal, 2000–3500 feet, 5. Fresno County: near Miramonte, 3200–3500 feet, 3. Kern County: twelve miles below Bodfish, 2000 feet, 1.

Remarks.—Osgood (1909, pp. 235–236) tentatively referred two immature specimens from the south-central Sierra Nevada, the only specimens available to him from that area, to *Peromyscus californicus californicus*. The series now contained in the Museum of Vertebrate Zoology, though small, is sufficient to indicate, as Osgood may have suspected, that a distinct race of *Peromyscus californicus* exists in that area.

Compared cranially with *P. c. californicus* from Monterey, *mariposae* differs as follows: rostrum tending to be somewhat shorter; zygomata relatively more broadly expanded; brain-case larger; anterior palatine foramina broader; audital bullae larger. As contrasted cranially with *P. c. insignis* from Dulzura, San Diego County, the following differences are noted: size of *mariposae* larger; zygomata more widely expanded; brain-case broader; rostrum broader; anterior palatine foramina wider; molar series heavier; audital bullae larger.

P. c. mariposae differs from both the races compared above in its somewhat darker coloration dorsally, in a more extensively white ventral coloration, and in complete absence of any pectoral spot.

One specimen from near Bodfish, Kern County, a subadult, while tending towards *insignis* in that it is quite pale dorsally, resembles *mariposae* in its ventral whiteness and its large skull.

Peromyscus californicus insignis Rhoads

Southern Parasitic Mouse

Peromyscus insignis Rhoads, Proc. Acad. Nat. Sci. Philadelphia, p. 33, February 21, 1895.

Peromyscus californicus insignis Mearns, Mam. Mex. Boundary, Bull. U. S. Nat. Mus., no. 56, p. 429. April 13, 1907.

Type.—Adult male, skin and skull; no. 8308, Academy of Natural Sciences, Philadelphia; Dulzura, San Diego County, California; collected by C. H. Marsh, August 21, 1893 (*fide* Osgood, 1909, p. 238; not examined by us).

Geographic range.—Southern coastal district of California at least from Ventura County (probably eastern Santa Barbara County) south, west of the interior deserts, to San Quintín (lat. 30° 29′), Lower California, Mexico. This includes the San Bernardino and San Jacinto mountains in California and the Sierra Juárez and Sierra San Pedro Mártir in northern Lower California. Extreme altitudinal occurrences, at sea level and 8000 feet. (See maps, fig. 1, No. 5, and fig. 2.)

Diagnosis.—Smallest and palest race of the species; pectoral spot present or absent, but never strongly marked. Skull, small; rostrum slender; zygomata not broadly expanded; brain-case narrow; tympanic bullae small but proportionately about as in *P. c. californicus*; maxillary toothrow short, with dentition weak.

Measurements.—Average and extreme measurements in millimeters of nine adults (2♂♂, 7♀♀) from points in southern San Diego County are as follows: total length, 238 (225–253); tail vertebrae, 136.4 (127–148); hind foot, 25.4 (25–27); greatest length of skull, 29.0 (28.4–29.8); basilar length, 22.4 (21.8–23.2); zygomatic width (average of 8),

14.5 (13.9–15.3); interorbital constriction, 4.6 (4.3–4.9); length nasals, 10.9 (10.4–11.4); shelf of bony palate, 4.4 (4.0–4.7); length palatine slits, 5.7 (5.4–6.0); diastema, 7.3 (7–7.6); postpalatal length, 11.1 (10.8–11.3); maxillary toothrow, 4.1 (4–4.3).

Average and extreme measurements in millimeters of eleven adults (9♂♂, 2♀♀) from the Sierra San Pedro Mártir, Lower California, are as follows: total length, 234 (220–

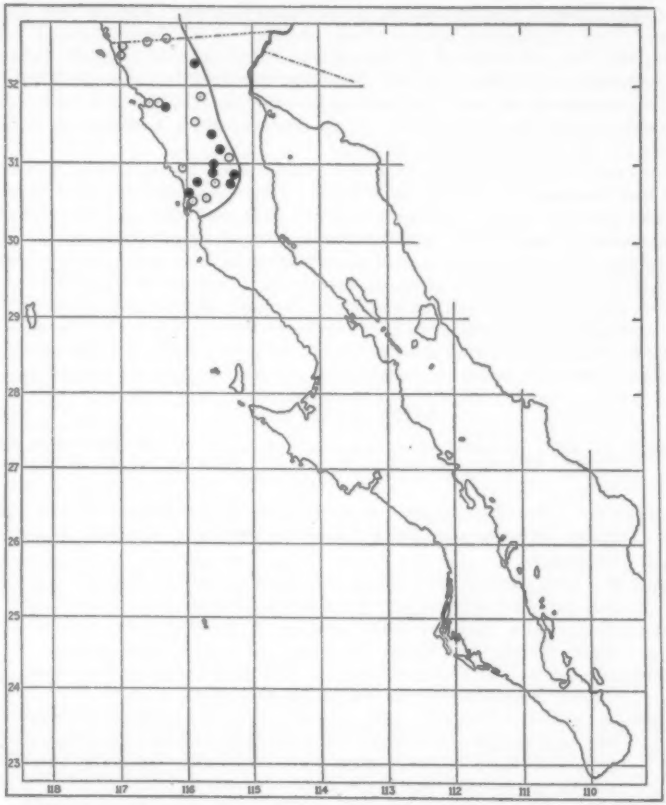


FIG. 2. Stations of occurrence of *Peromyscus californicus* (subspecies *insignis*) in Lower California. Solid circles mark localities whence specimens have been examined by the authors of the present paper; open circles mark stations of record otherwise. Assumed general range outlined.

252); tail vertebrae, 128 (117–143); hind foot, 25.2 (24–27); greatest length of skull, 29.0 (28.1–29.8); basilar length, 22.3 (21–23.2); zygomatic width (average of 10), 14.7 (13.5–15.1); interorbital constriction, 4.6 (4.4–4.8); length nasals, 10.6 (10.3–10.9); shelf of bony palate, 4.3 (3.9–4.6); length palatine slits, 5.7 (5.3–6.0); diastema, 7.4 (7–8.1); postpalatal length, 11.0 (10.3–11.5); maxillary toothrow, 4.2 (4–4.4).

Average weight of same eleven adults from Lower California, 33.2 grams.

Specimens examined.—A total of 219, representing the following localities: California: Ventura County: Matilija, 13. Los Angeles County: Linda Vista, near Pasadena, 23; Arroyo Seco Canyon, near Pasadena, 11; Scoville Hill, near Pasadena, 1. San Bernardino County: 5750 feet altitude, two miles east of Strawberry Peak, 2; two miles northeast of Grapeland, 3. Orange County: Trabuco Canyon, Santa Ana Mountains, 17; Santa Ana Canyon, Santa Ana Mountains, 2. Riverside County: Cabezon, 1700 feet, San Gorgonio Pass, 13; Banning, 3; Snow Creek, north side of San Jacinto Peak, 1; Schain's Ranch, 4900 feet, northwest slope San Jacinto Mountains, 15; Tahquitz Valley, San Jacinto Mountains, 1; Kenworthy, 2. San Diego County: Escondido, 5; Witch Creek, 2; Julian, 2; one and one-half miles south of San Onofre, 1; Warner Pass, 12; six miles north of Foster, 15; San Felipe Valley, 1; La Puerta Valley, 1; Mountain Spring, 1; Campo, 17; Jacumba, 7; Dulzura, 16.

Lower California: Los Pozos, 4200 feet, Sierra Juárez, 3; Las Cruces, 2600 feet, 20 miles east Ensenada, 3; Concepción, 6000 feet, 1; San José, lat. 31°, 4; El Valle de la Trinidad, 2500 feet, 6; near Valladares, 2700 feet, 7; Santo Domingo, 25 feet, lat. 30° 44′, 4; San Ramón, 1; San Antonio Ranch, 2100 feet, Santo Domingo River, 3.

Remarks.—The subspecies *P. c. insignis* appears to be more constant in its characters over a large area than any other race of the species. As noted by Grinnell and Swarth (1913, p. 334) specimens from the San Jacinto region differ in no appreciable respect from topotypes from Dulzura, San Diego County. A large series is available from the San Pedro Mártir region of Lower California, and a close study of these has failed to reveal any character wherein they might differ significantly from typical *insignis*.

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A STUDY OF THE IDAHO JUMPING MICE OF THE GENUS ZAPUS, WITH REMARKS ON A FEW SPECIMENS FROM BRITISH COLUMBIA

By William B. Davis

So far as is known, the only Idaho representative of the genus *Zapus* is the species *princeps*. Recent examination of specimens indicates that five geographic races of this animal occur within the state. Reference to the accompanying map, on which locality records are plotted, shows the species to be wide-ranging throughout the mountainous regions to the north and east of the Snake Plains. Further collecting undoubtedly will greatly extend known ranges and may result in the finding of these animals in the mountains of the drier southwestern section of the state.

These jumping mice typically inhabit grass-bordered streams and meadows in the Transition and Canadian life-zones, though individuals occasionally are taken on grassy ground in or near thickets of Douglas fir (*Pseudotsuga taxifolia*). Records of their occurrence in Idaho indicate that the mice range from 3000 feet altitude, as at Weippe, to 7500 feet at Smith Mountain.

The specimens from Idaho now in the collection of the Museum of Vertebrate Zoology constitute the main basis of this report. Most of these were collected by Robert T. Orr during the summer of 1932. However, other material of special importance in the present study comprises specimens from the Seven Devils Mountains, presented to the Museum by Mr. Ralph Ellis. The specimens from the "Salmon River Mountains," and topotypes of *Zapus princeps oregonus* Preble, which were necessary for comparison, were loaned by the United States Bureau of Biological Survey. The writer wishes to acknowledge his indebtedness to the officials of this Bureau for the opportunity to study this material.

1. THE RACES THAT OCCUR IN IDAHO

Zapus princeps idahoensis, new subspecies

Type.—Male, adult, skin and skull; no. 54845, Mus. Vert. Zool.; five miles east of Warm Lake, 7000 feet altitude, Valley County, Idaho; July 9, 1932; collected by Robert T. Orr; original no. 660.

Distribution.—Central Idaho from Lemhi County north and west to the Seven Devils Mountains.

Diagnosis.—A *Zapus* of the *princeps* group, resembling *Z. princeps oregonus*. General color: Above, near Clay color (Ridgway, 1912), this overlaid with black hairs that form a broad, dorsal, longitudinal darker band; sides lighter than back; lateral line indistinct or wanting; belly pure white, occasionally faintly tinged with ochre. Skull: Medium in size; incisive foramina relatively narrow (ratio of breadth to length 51% or less); tympanic bullae well inflated; post-palatal notch located anterior to posterior face of last molar.

Comparisons.—*Zapus princeps idahoensis* differs from *Z. p. oregonus* (two topotypes and eight other specimens from near the type locality available for comparison) as

follows: Skull smaller; incisive foramina relatively narrower (ratio of breadth to length 51 per cent or less in *idahoensis*, 53 per cent or more in *oregonus*); palato-frontal depth less (6.1 mm. as compared to 6.6 mm.); palatal bridge shorter (3.3 mm. as compared to 3.7 mm.); length of zygomatic arch (measured from posterior notch to anterior opening of lower portion of infraorbital canal) less; coloration less suffused with black hairs,

FIG. 1. GEOGRAPHIC DISTRIBUTION OF ZAPUS PRINCEPS IN IDAHO

1, *Z. p. kootenayensis*. 2, *Z. p. idahoensis*. 3, *Z. p. oregonus*. 4, *Z. p. cinereus*. 5, *Z. p. princeps*. Solid circle, specimens examined; solid triangle, specimens known to exist, but not examined by the author; circle with central dot, type locality of *idahoensis*.

and therefore more ochraceous in postero-dorsal view; hind foot smaller. From *Zapus princeps princeps* Allen (nine topotypes available), *idahoensis* differs as follows: Post-palatal notch anterior to posterior face of last molars rather than on a plane with, or posterior to, same; skull smaller, especially as regards palato-frontal depth, length of palatal bridge, and length of zygomatic arch; color paler; lateral line much more reduced. From *Zapus princeps kootenayensis* Anderson (two topotypes and specimens from

Meadow Creek, Boundary County, Idaho, which are definitely of this subspecies) *idahoensis* is distinguished as follows: Skull larger; incisive foramina larger; incisors shorter; zygomatic breadth greater; and greater suffusion of ochraceous dorsally, that is to say, more ochraceous when viewed postero-dorsally.

Remarks.—As judged by cranial characters and pelage, *idahoensis* is most closely related to *oregonus*. However, the smaller hind foot, the more highly inflated tympanic bullae, and the narrower incisive foramina in *idahoensis* clearly separate these two races. The position of the post-palatal notch in *princeps* is in itself sufficient to distinguish that race from all the *princeps* group save *Zapus princeps palatinus* Hall, while the grayer color, smaller incisive foramina and smaller skull of *kootenayensis* distinguish that race from *idahoensis*.

In color of pelage, the four specimens from Smith Mountain approach *oregonus*, that is, the mid-dorsal line is dark. However, in length of hind foot and in cranial features they agree with *idahoensis* and, in my opinion, are referable to that race. This condition of intergradation is to be expected, for specimens from the Cuddy Mountains, a few miles to the southward, are, in cranial features as well as in pelage, very close to the race *oregonus*.

Since these mice, in our western areas at least, are dependent upon the proximity of water to afford the necessary habitat, namely, grassy meadows or stream sides, we may assume that the inhabitants of a particular hydrographic area whose streams form a continuous network of waterways, some of which, at least, carry water throughout the year, and which is effectively isolated from another such area by mountainous or desert barriers, are of the same race. This assumption is borne out by the results of the present study. Those jumping mice that inhabit the drainage basin of the Weiser River, tributary to the Snake, are almost typical *oregonus*, while those that inhabit the Seven Devils Mountains, more specifically, Smith Mountain, whose water-ways drain into two separate hydrographic basins, namely the Weiser and the Salmon rivers, are on the periphery of two geographic areas and exhibit characters that indicate intergradation of the two races *oregonus* and *idahoensis*. The specimens from west of Payette Lake were taken within the drainage basin of the Salmon River and are clearly referable to *idahoensis*.

It would seem, thus, that the *Zapus* inhabitating the Salmon River drainage basin are of the race *idahoensis* while those inhabiting the drainage basins of the west-central portion of the state whose waters, in general, flow in a southwesterly direction are *oregonus*. This, as regards the material at hand, is the situation, save for two specimens from Alturas Lake. These two appear to be more closely related to the race *oregonus*, though many differences, which are discussed below, are evident. From a geographical point of view, it seems probable that if jumping mice inhabit the drainage basins of rivers to the south and west of the Sawtooth Mountains, they will be found to be most like *oregonus*, for, save in very few instances, the Sawtooth Mountains constitute an effective barrier. It may be that the *Zapus* at Alturas Lake represent stock that has migrated from the westward, up the Payette River and through a low pass in the mountains, to this locality.

Five specimens (two males, two females and one unsexed individual), labeled "Salmon River Mts.," were collected by Merriam, Bailey, and Dutcher in 1890. Since that time the name Salmon River Mountains has come to designate a range that is west of, and parallel to, the Salmon River, and in which Merriam and his associates did no collecting. The name Lemhi Mountains now applies to the mountain range in which these specimens were collected. This series, though differing from the Warm Lake (type locality) specimens in minor respects, more specifically, in having slightly smaller crania and relatively longer tails, agrees with them in most cranial characters as well as in color of pelage and in size of hind foot.

Measurements.—Averages, with maxima and minima, in millimeters, of six adults, four males and two females, from the type locality are as follows: Total length, 240 (253–231); tail, 144 (152–139); hind foot, 31 (32–30); occipito-nasal length, 24.3 (24.8–24.0); zygomatic breadth 12.2 (12.6–12.0); interorbital constriction, 4.6 (4.7–4.4); breadth of cranium, 10.4 (10.8–10.2); palato-frontal depth, 6.1 (6.3–5.9); maxillary tooth row, 4.3 (4.4–4.1); length of palatal bridge, 3.3 (3.4–3.1); posterior edge of incisive alveolus to post-palatal notch, 9.3 (9.6–9.1); foramen magnum to post-palatal notch, 8.6 (8.8–8.3); length of zygomatic arch (measured from posterior notch to anterior opening of inferior infraorbital canal), 9.3 (9.8–8.9); breadth of rostrum (measured between the two inferior infraorbital canals), 5.2 (5.3–5.0); length of incisors (measured vertically from dorsal face of nasals to inferior edge of incisors), 6.5 (6.7–6.4).

Specimens examined.—Total number 21, as follows: Five miles east of Warm Lake, 7000 ft., Valley County (type locality), 6; five miles west of Cape Horn, 7000 ft., Valley County, 1; summit Smith Mountain, 7500 ft., Adams County, 3; one mile north of Bear Ranger Station, southwest slope of Smith Mountain, 5400 ft., Adams County, 2; three miles west of Payette Lake, 5400 ft., Adams County, 4; "Salmon River Mts." (= Lemhi Mountains), 5.

Zapus princeps princeps Allen

In attempting to work out the taxonomy and distribution of the *Zapus princeps* group within the bounds of the state of Idaho, I have found it necessary to study critically several of the geographically adjacent races of this species, among which is *Zapus princeps princeps*. This race is represented in my material by a series of nine topotypes, six males (four adults and two young) and three females (two adults and one young), collected seven miles north of Florida, Florida River, 7146 feet elevation, La Plata County, Colorado, by Miss Annie M. Alexander and Miss Louise Kellogg.

Allen (1893, p. 71), in his description of this race, speaks of the coloration of the sides as "yellowish brown slightly varied with blackish, except over a narrow lateral line adjoining the white of the lower parts which is clear strong yellowish brown." I wish to emphasize the diagnostic value of this lateral line. When our topotypes are compared with any of the other races that Hall (1931, p. 10) includes as subspecies of this species (I have not had the opportunity to examine *Zapus princeps minor* Preble), the strength and clearness of the lateral line immediately catches the eye. In *oregonus* and *kootenayensis* the line is present, but very much reduced; in *Zapus princeps curtatus*, *Z. p saltator*, *Z. p. cinereus*, *Z. p. palatinus*, *Z. p. major*, and *Z. p. nevadensis* it is practically absent.

I can find no mention in the literature at hand concerning the character of the palate that is characteristic of the series of *Z. p. princeps* before me. In all the specimens, save the three young in which the third molar is just emerging, the post-palatal notch is on a plane with, or posterior to, the posterior border of the last molar. In all the other races of this species that I have studied, save *palatinus*, the post-palatal notch is decidedly anterior to the posterior face of the last molar. The much grayer pelage and larger incisive foramina of *palatinus* readily separate that race from *princeps*.

A communication from Dr. R. M. Anderson, Chief, Division of Biology, National Museum of Canada, under date March 5, 1934, states that in a series of 90 specimens of *Zapus* of the species *princeps* from Waterton Lakes National Park, Jasper Park, and Banff, Alberta, and from Newgate, Mica Mountain, and Vanderhoff, British Columbia, 88 specimens have the post-palatal notch anterior to the hinder border of the last molars; in the other two it is on a plane with same. This fact indicates to me the possibility of the existence of an undescribed race of jumping mice inhabiting the Rocky Mountains in the northern part of the United States and the southern portion of Alberta and British

Columbia. Certainly these specimens do not conform to our topotypes as regards the position of the post-palatal notch.

Adults only (determined by the amount of wear on the last molars), taken in late June and July, therefore supposedly of comparable pelage, have been used in these comparisons.

Zapus princeps princeps is accredited to Idaho on the basis of eight specimens, from the Preuss Mountains in the southeast corner of the state, that Preble (1899, p. 23) classed as *princeps*. I have not had the opportunity to examine these.

Zapus princeps cinereus Hall

Two adult females are listed by Whitlow and Hall (1933, p. 268) from Camp Tendoy, some twelve miles south of Pocatello, Bannock County. Although, as these authors say (*op. cit.*), these specimens are not typical of *cinereus*, they are best referred to that race at least until further material is available for comparison.

Zapus princeps oregonus Preble

Two specimens, one male and one female, from Alturas Lake, 7000 ft., Blaine County, are best referred to this race, as are five specimens, three males and two females, from one mile north of Heath, southwest slope of Cuddy Mountain, Washington County. The Alturas Lake specimens are not typical of *oregonus* in that the tympanic bullae are considerably larger and more highly inflated, the incisors are longer, and the color of the sides is much grayer. In all three of these characters these two specimens greatly resemble *palatinus* from Nevada. Further collecting in this area, and in that to the south, may reveal the presence of the Nevada race in Idaho, although on geographical grounds this seems unlikely. The specimens from the Cuddy Mountains are typical of *oregonus* save that, in two of the five specimens, the post-palatal notch is almost on a plane with the posterior border of the last molar. Here, again, an approach toward *palatinus* is indicated.

Zapus princeps kootenayensis Anderson

This subspecies, in Idaho, is limited to the northern part of the state, ranging as far south as the drainage system of the Clearwater River. Two specimens from four miles west of Meadow Creek, 3000 ft., Boundary County, just a few miles south and east of the type locality, are definitely *kootenayensis*, but one specimen, a sub-adult, is heavily suffused with ochraceous dorsally, while the other has the typical "dusty color" that Anderson (1932, p. 109) mentions as distinctive of this race. On the basis of these and other specimens from Idaho referable to this race, it would seem that this subspecies exhibits a wide range of color variation. Anderson intimates that such color differences are present in material studied by him.

These differences in color may well be due to season or to age. The series of *Z. p. oregonus* before me indicates that in late spring (May) the adults of this subspecies are darker, both dorsally and laterally, than are specimens taken in late summer. Adult specimens taken in August are more suffused with ochraceous dorsally and, especially, laterally. An immature specimen, collected July 30, is very heavily suffused with ochraceous so that, when viewed postero-dorsally in sunlight, the dorsum is very little different in color from the sides. A young specimen, which I have referred to *kootenayensis*, from Cocolalla, Idaho, taken July 16, is in similar pelage, and, by this criterion alone, indistinguishable from the immature specimen of *oregonus*.

A topotypical specimen of *kootenayensis*, collected July 26, and an old male from Glidden Lakes, Idaho, collected July 23, are of especial interest in that they represent

a stage in the moulting process. The entire pelage, save on the belly, is plumbeous in appearance, sprinkled here and there on the sides with ochraceous; all this is overlaid with long, black guard hairs. Underneath the plumbeous surface the new fur, ochraceous in color, and about 3 mm. in length, is appearing over the entire dorso-lateral area. On the basis of these two specimens it seems that the mid-summer moult takes place over the entire dorsum at the same time, accomplished by gradual dropping out and replacement of the individual hairs in such a manner that no moult line is produced.

Specimens from Idaho that are referable to *kootenayensis* are as follows: One male and one female from five miles west of Cocolalla, 3500 ft., Bonner County, which, in cranial measurements, average slightly smaller than topotypes; four adults, two of each sex, from Glidden Lakes, 5700 ft., Shoshone County, not typical in that the two females have much larger incisive foramina than our topotypes; three sub-adult males from two miles northeast of Weippe, 3000 ft., Clearwater County; two females from four miles west of Meadow Creek, 3000 ft., Boundary County.

One specimen from Cedar Mountain, Latah County, Idaho, in the Charles R. Conner Museum, Pullman, Washington, which I have not examined, and which Mrs. Ruth Dowell Svihla informs me is labeled "*Zapus princeps oregonus*," will, I believe, be found to be referable to *kootenayensis* rather than to *oregonus*.

2. REMARKS ON SPECIMENS FROM BRITISH COLUMBIA

Nine adult specimens of *Zapus* from Indianpoint Lake, fifteen miles north of Barkerville, British Columbia, collected by T. T. and E. B. McCabe are, in my opinion, definitely referable to *Zapus princeps saltator* Allen rather than either to *Z. p. princeps* or to *Z. p. kootenayensis*. This series agrees closely with topotypes of *saltator* in the fifteen cranial measurements and in coloration of pelage. However, in one cranial feature, namely, the ratio of "distance from incisor to post-palatal notch" to "distance from foramen magnum to post-palatal notch," the Barkerville specimens tend more toward *princeps*. These specimens differ from our topotypes of *princeps* most noticeably in the following respects: Post-palatal notch anterior to last molar rather than even with or posterior to same; dorso-lateral area much darker. From *kootenayensis* they differ as follows: Skull averaging longer and broader; incisive foramina larger; dorso-lateral area more heavily over-cast with ochraceous.

Two specimens from Chezacut Lake, Chilcotin, British Columbia, in the Kenneth Racey collection, Vancouver, B. C., which were made available for study through the courtesy of Ian McTaggart Cowan, Museum of Vertebrate Zoology, Berkeley, are regarded by the writer as intergrades between *saltator* and *kootenayensis*, the races respectively to the west of, and to the southeast of, this locality. In general coloration of pelage, one of the Chezacut specimens, no. 837, is decidedly like *kootenayensis*, the other, no. 1159, tends more toward *saltator*, especially as regards the dorso-lateral area. The skulls, however, definitely show their relationship to *saltator*—that is to say, they are longer and broader than in *kootenayensis*. The position of the post-palatal notch alone is sufficient to distinguish these specimens from those of *Z. p. princeps*. Although regarded as intergrades, they are, I believe, best referred for the time being to *saltator* rather than to *kootenayensis*.

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Museum of Vertebrate Zoology, Berkeley, California.

ANTROZOUS BUNKERI, A NEW BAT FROM KANSAS

BY CLAUDE W. HIBBARD

While making a survey of the bats inhabiting the caves and sink holes in Barber County, Kansas, we took a series of 25 specimens of *Antrozous* which represents a distinct species hitherto undescribed.

I am greatly indebted to the following persons for the loan of specimens of the genus *Antrozous* used in this study: Mr. C. D. Bunker, Univeristy of Kansas Museum of Birds and Mammals, Lawrence, Kansas; Dr. W. H. Burt, California Institute of Technology, Pasadena, California; Dr. Joseph Grinnell, Museum of Vertebrate Zoology, University of California, Berkeley, California; Mr. F. S. Miller, Department of Mammals, Colorado Museum of Natural History, Denver, Colorado; and Dr. Alexander Wetmore, United States National Museum. I am indebted also to Dr. H. H. Lane, under whose general direction the work has been done, and to Dr. E. H. Taylor, for much helpful criticism and advice.

The new bat may be designated as:

Antrozous bunkeri, new species

Type.—Female adult, skin and skull; no. 9302, Univ. of Kansas Museum of Birds and Mammals; collected by Hobart Smith and Claude W. Hibbard, September 2, 1933, 7 miles south of Sun City, Barber County, Kansas, in the tunnel by the Natural Bridge on the south fork of Bear Creek.

Distribution.—Known only from the type locality.

Diagnosis.—Size approximating that of *Antrozous pacificus*. Skull similar to that of *A. pacificus* but averaging slightly smaller and differing further in that the supraoccipital region is not as pointed, the brain case is more inflated and rounded, the auditory bulla covers less of the cochlea, and the zygomatic arch is weaker. Color on upper surface quite similar to that of *A. pacificus*, but more diffused and with a slightly browner pigment on tips of hairs; underparts grayish white, as in *A. pallidus*.

Color.—Type: On the upper parts of the body the hairs are cream buff (Ridgway, 1886) at their bases; on the posterior part of the back and on the sides as far forward as the nuchal region they are tipped on terminal fourth with broccoli brown (Ridgway, 1886). In the scapular region the brown part of the hairs is absent or is present only at

extreme tips, giving the appearance of a light area. In front of this in the nuchal region is a distinct narrow area of hairs showing broccoli brown tips, giving the effect of a collar, reaching to the base of the ears; running forward on the median line between the ears to the forehead is a similarly colored area. On the ventral surface of the body the hairs are grayish white and along the sides of the body they are slightly suffused with pale cream buff. The ears are slightly darker than those of *Antrozous pacificus*, but the wing membranes and feet are of the same sepia color. The wing membrane has a narrow border of ecru drab along the outer edge, one millimeter in width.

The color of the immature specimens differs from that of the adults only in the dorsal region, where the bases of the hairs are a pale cream buff and the tips are sepia.

Skull and *teeth*.—The skull resembles in general that of *Antrozous pacificus* but averages slightly smaller. It differs from that of *A. pacificus* in that the supra-occipital region is not as pointed, the auditory bulla covers less of the cochlea, and the contour line of the skull is of an even convexity and is not broken by the slightly raised portion of the posterior part of the rostrum. The braincase is not actually wider than that of *A. pacificus*, but it is rounder and somewhat more inflated, both anteriorly and posteriorly, near the median line. This gives it a broader appearance. The zygomatic arch is weaker for the size of the skull than in the other forms of *Antrozous*. The jaw is not as heavy as that of *Antrozous pacificus* and the average length is one millimeter less.

The canine teeth are smaller than those of *Antrozous pacificus*, but they show a relatively deeper groove on the lateral posterior surface. Though the premolar has been of value in separating *A. pallidus* from *A. pacificus*, it is so variable in *A. bunkeri* that it is of little or no value in separating this from the others. The other teeth are larger than those of *A. pallidus* and slightly smaller than those of *A. pacificus*.

Measurements in millimeters.—Type, female adult: Total length, 126; tail, 47; hind foot, 14; forearm, 56; ear, 28; tragus, 16. Average and extremes of twelve adult females (type and eleven paratypes): 122 (115–130); 48 (40–52); 13.5 (12–15); 55 (51–58); 27.1 (26–28); 15.5 (15–16). *Skull* (type): Greatest length 21.5; condylobasal length, 19; zygomatic breadth, 13.5; interorbital constriction, 4.2; breadth of braincase, 9.3; mastoid breadth, 10.5; occipital depth, 7; maxillary tooth row, 7.5; maxillary breadth at M^3, 9; mandibular tooth row, 9. Average and extremes of twelve adult females (type and eleven paratypes): 21.3 (20.5–22); 19.7 (19–20.6); 13.5 (13–14); 4.2 (4–4.5); 9.4 (9–10); 10.7 (10.4–11); 7.2 (7–7.5); 7.6 (7.2–8); 8.6 (8.5–9); 8.7 (8.5–9).

Remarks.—Twenty-five specimens of *Antrozous bunkeri* have been examined and studied, all from the type locality: 12 adult females, 10 immature females, and 3 immature males.

Antrozous bunkeri shows the greatest individual variation of any of the forms of the genus *Antrozous*. It may at once be distinguished from *A. pallidus* and *A. minor* by its size and coloration, and from *A. pacificus* by the grayish white color of the hairs of the ventral surface, a character likewise found in *A. pallidus*. It shows closer relationship to *A. pacificus* than to any other form.

Despite the fact of its close relationship to *Antrozous pacificus* it has been deemed wise to give the form specific rank, owing to the fact that it is apparently isolated some 700 miles from the nearest locality in which *A. pacificus* occurs, as well as to the fact that it shows no intergradation with *A. pallidus*, which should occupy a wide area to the west between *A. bunkeri* and its nearest relative. It seems hardly likely that *A. pallidus* and *A. bunkeri* will occupy the same range since the ranges of *A. pacificus* and *A. pallidus* meet but do not overlap.

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KOREAN MAMMALS PRESERVED IN THE COLLECTION OF MARQUIS YAMASHINA

By Nagamichi Kuroda

Marquis Yamashina sent Mr. H. Orii to the Korean Peninsula and Quelpart Island, in 1929 and 1930, for zoological exploration. In these regions Mr. Orii obtained a good series of mammals, some of which have already been identified by Mr. Kishida; but many others are still undetermined. Recently Marquis Yamashina requested me to re-identify these specimens and to publish descriptions of them.

I am greatly indebted to the Marquis for the privilege of publishing this article, with descriptions of several forms of mammals apparently new to science.

Family CERVIDAE

Capreolus pygargus pygargus (Pallas)

Japanese: Ônoru

One male (summer pelage) without skull; Non-sa-ton, Kankyo-hokudo, north Korea; November 4, 1929.

Coloration.—Similar to the European *C. capreolus*, but brighter and lighter rufous, without a pale rump-patch; front to hind neck tinged with brown, forming an indistinct longitudinal line; well-defined umber brown moustache-marks on the lips.

Measurements.—Head and body, 1220 mm. (in skin); hind foot, 340 (in flesh); ear, 130 (in flesh); height at shoulder, 697 (in skin).

This skin is apparently lighter rufous than that of the *Capreolus bedfordi* of Thomas and the umber brown moustache-marks on lips show that it should be identified as *pygargus* rather than *bedfordi*, which has less brown on lips, or nearly none.

Family MUSTELIDAE

Mustela sibirica (? manchurica Brass)

Japanese: Shiberica-itachi (?)

One adult female (summer pelage); Chian Zen, 2000 feet altitude, Kogendo, east Korea; July 12, 1929.

One adult male (winter pelage); Bam-po, Kankyo-hokudo, north Korea; November 8, 1929.

Measurements (in the flesh) of female and male.—Head and body, 266, 320; tail, 147, 165; hind foot, 46, 68; ear, 23, 24.

Remarks.—I have compared these two skins with a Manchurian (male in winter), a Korean (female in summer) and two Tsushima (male in winter and female in summer) skins and found that the Manchurian skin is much brighter fox-red, without any dark color on back and tail. The male from Bam-po is much paler throughout, without any fox-reddish wash, and the Tsushima male has its back and tail hairs perceptibly washed with dark color. From the above comparisons, it seems that Kishida and Mori[1] prob-

[1] Kishida, in Kishida and Mori, "Dobutsugaku Zasshi", vol. 43, p. 380 (April 15, 1931).

ably are correct in separating the North Korean animal and those from the principal parts of Korea and from Tsushima. They have named the former as "*Kolonocus sibiricus katsurai*" and the latter as "*K. sibiricus peninsulae.*" On the other hand, A. B. Howell[3] has united the examples from Imiempo and Sansing in Manchuria with those (4 juveniles) from Seoul in Korea, referring them to *manchurica* Brass. At the present time, I have much hesitation in giving the two different names to the above skins, considering that it is much safer to adopt the name *manchurica* for these animals, until a far larger series can be examined.

Family CANIDAE

Canis lupus coreanus Abe

Japanese: Chôsen-ôkami. Korean: Nukutei

1923. *Canis lupus coreanus* Abe, "Dobutsu. Zasshi," vol. 35, pp. 383, 384, 386 (Korea). (In Japanese).

One juvenile male; San Cho, north Korea; September 7, 1929.

Coloration.—Dorsal parts of body buffy white, with many intermixed black woolly hairs on median dorsal region; tail short, about one-third the length of the head and body, and tipped with black; forehead, back of ears, and neck tinged with grayish rufous; fore and hind feet buffy white, the former with a longitudinal black line on the basal half.

Measurements (in the flesh).—Head and body, 1065 mm.; tail, 335; hind foot, 230; ear, 115.

Skull.—Greatest length, 209 mm.; basilar length, 195; breadth of braincase, 66; occipital depth, 64.9; mandibular tooth row (including incisors), 114; foramen incisivum, 13.9; auditory bulla, 27.5 x 18.9; greatest length of lower jaw, 163.5.

Family LEPORIDAE

Lepus coreanus Thomas

Japanese: Chôsen-nousagi

Male (summer pelage); Riugan-po, Heian-hokudo, northwest Korea; July 3, 1929.

Male and female (both in winter pelage); Moppo, south Korea; January 11, 1930.

A pair from Moppo have grayer and paler coat, while one from Riugan-po has more buffy or cinnamon on back, sides of body, fore limbs, and throat; ears of the latter specimen much darker brownish and upper side of tail much more black than in the winter specimens.

Family SCIURIDAE

Eutamias asiaticus orientalis (Bonhote)

Japanese: Chôsen-shimarisu

Two males, two females, and one unsexed (summer pelage); Chian Zen, Kogendo, 500–2000 feet, east Korea; June 21–July 6, 1929.

Three males, two females and one female juvenile (summer pelage); Non-sa-ton, Kankyo-hokudo, 6000 feet, north Korea; July 24–August 25, 1929.

In the present form, the dark dorsal lines usually vanish on the rump, but a female from Chian Zen has the three median dark lines very strongly marked. The dark lines

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[3] Howell, Proc. U. S. Nat. Mus., vol. 75, Art. 1, p. 27, (1929).

vary from dark (brownish black) to pale (dusky blackish brown), and the four dorsal buffy lines also vary from dark (buffy) to pale (nearly white); these variations are not sexual. There is another variation of the two median pale lines, which have a very strong wash of rusty in some skins, while in others they have a very pale wash of the same color.

Sciuropterus russicus aluco Thomas

Japanese: Chôsen-momonga

Male and female (winter pelage); Non-sa-ton, Kankyo-hokudo, 6000 feet, north Korea, December 29, 1929.

I have considered that *Sciuropterus aluco* is a Korean form of *S. russicus* as already suggested by Thomas.[3]

Anderson obtained only one female at Kaloguai, 55 miles northeast of Seoul, so that the present skins seem to furnish the second record of this subspecies from Korea.

Family MURIDAE

Microtus pelliceus Thomas

Japanese: Yoshi-nezumi

Five males, one female, one juvenile male, two juvenile females; Bam-po, Kankyo-hokudo, north Korea; October 11–November 18, 1929.

Measurements.—Head and boby, 87–148; tail, 43–69; hind foot, 21–24; ear, 13–16; greatest length of skull, 29.5–33 mm.

This is one of the largest voles found in the Far East; it is recorded from Ussuri (type locality) and Manchuria, ranging into the northernmost parts of Korea, where it is now recorded for the first time. I have a young one of this species from Rantô, a small island off Yûki in the same district.

Its upper molars are similar in shape to those of *Microtus montebelli* from Japan; but the first lower molar has only three angles on the outer side, instead of four angles as in the latter species.

Clethrionomys rufocanus regulus (Thomas)

Japanese: Kôsai-yachinezumi

Two males (summer pelage); Chian Zen, Kogendo, 300 feet, east Korea; June 20 and 26, 1929.

Two females (winter pelage); Rei Ko, 800 feet, south Korea; March 1, 1930.

Fur in winter pelage is cinnamon rufous, 8–9 mm. in length on the back, while in summer it becomes dark rufous and shorter in length.

Cricetulus triton nestor Thomas

Japanese: Kinuge-nezumi

1914. *Tscherskia albipes* Ognev, Moskva Dnev. zool. otd. obšč. liub. jest., II, p. 102 (Southern Ussuri).

1929. *Asiocricetus bampensis* Kishida, "Lansania," Tokyo, vol. 1, no. 10, December 21, 1919, pp. 148, 150 (Bam-po, north Hangieng, 50 feet—adult male).

1929. *Asiocricetus yamashinai* Kishida, loc. cit., p. 156 (Bam-po, north Hangieng, 50 feet—subadult male).

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[3] Proc. Zool. Soc. London, 1907, p. 465.

the southern ones in the coloration of back and variation of the dark dorsal line. This line is very variable in both series, and is not constantly well-developed in the northern ones, as stated by Thomas to be the case in the Manchurian form (*mantchuricus*). So I have united the northern and southern series from the Korean Peninsula, as well as that from Quelpart Island, under the name *coreae*. The male from Kim Kua has the dark dorsal line nearly obsolete, only faintly traced on the lower back and rump. I think this is an extremely unusual example of *coreae*. In the northern series a male from Bam-po has a much paler dorsal line than in most examples in the southern series. It should be compared with true *mantchuricus*, but unfortunately I have no skins of the latter.

Micromys minutus ussuricus Barrett-Hamilton

Japanese: Chôsen-kayanezumi

One nest; Dai-gan-do, Kankyo-hokudo, north Korea; October 10, 1929.

One young female with a nest; Bam-po, Kankyo-hokudo, north Korea; October 26, 1929.

Three young males, two young females with a nest; same locality; October 30, 1929.

The three nests collected were all rather smaller in size than that of *M. m. hondonis* from Japan; two are spherical and one is elliptical; the latter measures about 131 x 60 mm. Nests were found in coarse grass from 455 to 605 mm. above the surface of the ground. Five young in a nest show the body dark grayish brown above, pure white below, with gray bases to the hairs; tail shorter than head and body.

Rattus rattus alexandrinus (Geoffroy)

Japanese: Ejiputo-nezumi

One male; Moppo, south Korea; January 1, 1930.

Two females; Seikiho, 50 feet, Quelpart Island; March 20, 23, 1930.

The Moppo skin has its underparts grayish-buff, while two from Quelpart Island have buffy underparts.

Rattus norvegicus norvegicus (Erxleben)

Japanese: Shichirô-nezumi

Two males, one female, three juvenile males; Chian Zen, Kogendo, 300 feet, 500 feet, and 2000 feet, east Korea; June 22–July 12, 1929.

One male, two females; Bam-po, Kankyo-hokudo, 50 feet, north Korea; October 11–15, 1929.

One male, one unsexed adult; Chi-to Island, near Moppo, south Korea; February 14, 1930.

One juvenile male; Seikiho, Quelpart Island; March 29, 1930.

The typical Norway rat of the ordinary coloring, with the hind foot varying from 30–38 mm. in adults.

Mus bactrianus yamashinai, subsp. nov.

Japanese: Chôsen-hatsukanezumi

1931. *?Mus kambei* Kishida, in Kishida and Mori, "Dobutsugaku Zasshi", vol. 43, p. 378 ("Shusen" [= principal parts of Korea] and Quelpart Island); *nomen nudum.*

1931. *?Mus takagii* Kishida, loc. cit., p. 378 ("Shusen" [= principal parts of Korea]); *nomen nudum!*

One male, one female (summer pelage); Riugan-po, Heian-hokudo, northwest Korea, May 26, 28, 1929.

One male (summer pelage); Chian Zen, Kogendo, 50 feet, east (?) Korea; June 22, 1929.

One female (winter pelage); Kim Kua, Kogendo, east Korea; November 28, 1929.

Three males (winter pelage); Moppo, 30 feet, south Korea; December 31, 1929–January 3, 1930.

Three females (winter pelage); Chi-to Island, near Moppo, south Korea; February 13, 1930.

Type.—Adult male (Marquis Yamashina coll., no. 122); Moppo, 30 feet; south Korea; collected December 31, 1929, by H. Orii.

Characters.—Winter pelage: Fur soft and fine. Upper parts drab grayish or slightly washed with cinnamon buffy, with slaty bases to the hairs and intermixed with longer black hairs; underparts pure white, the hairs without grayish bases, but in some specimens, chest and median parts white with slight pale grayish bases to the hairs; border of dorsal and ventral surfaces very well defined. Summer pelage: Upper parts, especially the rump, distinctly tinged with rusty; dorsal parts darker brown; underparts as in the winter pelage, except one (no. 2, probably abnormal) which has them gray with some white hairs in patches on the sides of body. Tail distinctly shorter than head and body, varying from 42 to 48 per cent of total length. Tail brown above, white-haired below. Upper side of hands and feet white, except no. 2, which has them grayish white.

Measurements (in the flesh.)—

NUMBER	SEX	HEAD AND BODY	TAIL	HIND FOOT	EAR
1	♀[♂] ad.	79	58	14	12
2	♂ ad.	72	56	15	11.5
7	♂ ad.	77	59	17	11.5
112	♀ ad.	71	53	15	12 (with 6 embryos)
122 (type)	♂ ad.	70	64	16	13
124	♂ ad.	64	59	15	11
126	♂ subad.	59	57	14.5	10.5
142	♀ ad.	72	59	15	11
143	♀ ad.	75	60	15	11
144	♀ ad.	73	60	15	11

Skull measurements (type).—Greatest length, 20 mm.; basilar length, 16; zygomatic breadth, 10.5; length of nasals, 7; upper molar series, 4.

Remarks.—Nos. 142–144 from Chito Island, near Moppo, are rather paler cinnamon-drab on the back than those from Moppo (nos. 122, 124, 126); but the difference is not very pronounced, so I have united them with the present form. The new form, *yamashinai*, is nearly the same size as the Hokkaido form, *Mus molossinus yesonis* Kuroda[8], but the latter never has pure white ventral parts and the dorsal parts are much darker and less brownish. It seems to be very closely allied, if not identical with, the Manchurian form, *Mus bactrianus manchu* Thomas; but the latter is said to be a dark drab-gray

[8] Journ. Mammalogy, vol. 9, no. 2, p. 147, 1928.

above, slightly lighter on the underparts, not white. Kishida (loc. cit.) has named *Mus "kambei"* and *Mus "takagii"*, both from the Korean Peninsula, without description of either. From a study of the above series, I cannot agree with Kishida's opinion in recognizing two forms from Korea.

Family SORICIDAE

Crocidura dsinezumi quelpartis, subsp. nov.

Japanese: Saisiu-jinezumi

One male (winter pelage), no. 147; Seikiho, Quelpart Island, Korea; date not given, but the specimen was probably taken late in March, 1930.

Type.—Adult male above mentioned. H. Orii, collector.

Characters.—Size as large as in *Crocidura dsinezumi* (Temminck) from Kiusiu, Japan, but tail slightly longer (5 mm.); upper tooth row, including incisors, longer (8.2 mm. instead of 7.8 mm.); tip of i^1 to tip of p^1 also longer (4.9 mm. instead of 4 mm.); incisors and other teeth more robust than those of *dsinezumi*. Compared with the winter pelage of *dsinezumi*, the present form has very brown back (nearly sepia brown, instead of umber brown), while the under side is a trifle paler and much darker than in *C. coreae*. Hands and feet brownish white; tail dark brown above, whitish on the basal half of the under side; tail well haired, with bristles numerous as in *coreae*.

Measurements (in the flesh).—Head and body, 70 mm.; tail, 45; hind foot, 12.5; ear, 8.5. Skull, greatly damaged, seems to be larger than that of *dsinezumi* and *coreae;* interorbital breadth, 4 mm.

Remarks.—This unique specimen from Quelpart Island is possibly an intermediate form between *dsinezumi* and *coreae;* it most resembles the former, so that I have considered this shrew to be an insular form of *dsinezumi*. Possibly *coreae* will prove to be a peninsular form of *dsinezumi*, with the new form, *quelpartis*, as a connecting link.

Crocidura (? dsinezumi) coreae Thomas

Japanese: Chôsen-jinezumi

One female (summer pelage) and one female (winter pelage); Bam-po, Kankyo-hokudo, 50 feet, north Korea; September 17, November 5, 1929.

Two females (winter pelage); Moppo, 30 feet, south Korea; December 31, 1929, January 10, 1930.

Measurements (in the flesh).—

NUMBER	LOCALITY	SEX	HEAD AND BODY	TAIL	HIND FOOT	EAR
36	Bam-po	♀	65	31	11	6
100	Bam-po	♀	58	35	12	7
121	Moppo	♀	59	36	11	7
131	Moppo	♀	55	43	12	7

Skull measurements.—Greatest length, 17–18 mm.; condylobasal length, 16.8–17.5; basilar length, including incisors, 14.9–15.5; greatest breadth, 7.5–8.5; interorbital breadth, 3.9–4.1; front of i^1 to back of m^3, 7.5; tip of i^1 to tip of p^1, 4 mm.

The summer pelage is seal brown above, darker than the winter pelage, which is grayish brown. The under parts are dusky grayish white, darker than in the winter coat.

Mori[9] has described a species from Seoul under the name of *Crocidura longicauda*, giving the measurements as follows: Head and body, 48 mm.; tail, 14; hind foot, 12; ear, 7. Skull: Greatest length, 17.5; basal length, 15; interorbital breadth, 4; front of i^1 to back of m^3, 7.5. I am very doubtful as to the validity of *longicauda*; the dimensions, both external and cranial, are exactly like those of some of the specimens in the present collection, except that the length of head and body is perceptibly less (2 adults and 1 immature examined by Mori). In Central Korea we have also *coreae* (type from Min-gyong, 110 miles southeast of Seoul; also found in North and South Korea). *C. longicauda* must be compared with larger series of both forms before this question can be settled.

Crocidura lasiura lasiura Dobson

Japanese: Shiragi-jinezumi

Four adult males (summer pelage), five females (summer pelage), one unsexed (summer pelage), one unsexed (winter pelage); Bam-po, Kankyo-hokudo, north Korea; September 21–October 27, 1929.

Measurements (in the flesh).—Head and body, 83–98; tail, 33–43; hind foot, 13–18; ear, 7.5–9 mm. Skull: Greatest length, 21.5–24; basilar length, 19–21.5; greatest breadth, 9.5–10.5 mm.

Hands and feet blackish brown. The summer coat has short hairs of blackish gray; underparts more gray. The winter coat has rather longer hairs of brownish gray; underparts delicate gray.

Crocidura lasiura thomasi Sowerby

Japanese: Tomasu-jinezumi

Four males (winter pelage), three females (winter pelage); Kim Kua, Kogendo, east Korea; November 27–December 4, 1929.

One male, one female (both in winter pelage); Moppo, south Korea, January 9, 11, 1930.

Measurements (in the flesh).—Head and body, 79–91; tail, 36–48; hind foot, 14–17; ear, 8–9 mm. Skull: Greatest length, 21–23; basilar length, 19.5–20.5; greatest breadth, 9.5–10.9 mm.

Hands and feet brownish and not so blackish as in *Crocidura lasiura lasiura*. The above skins are all in the winter pelage and very similar in coloration to true *lasiura* in winter pelage, but somewhat paler and more brownish.

The length of head and body (on an average) and of hind foot slightly shorter than in *lasiura*, as considered by Sowerby; but the tail is not noticeably shorter as supposed by him. From these circumstances, I cannot sustain *thomasi* as a species, and have to consider it a central and southern race of *lasiura*.

Howell[10] has recorded a skull of this form from Fusan, South Korea, as *Crocidura lasiura*.

Crocidura yamashinai, sp. nov.

Japanese: Yamashina-jinezumi

1931. ?*Crocidura lizenkani* Kishida, in Kishida and Mori, "Dobutsugaku Zasshi", vol. 43, p. 377, April 15, 1931, North Korea; *nomen nudum*.

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[9] Journ. Chosen Nat. Hist. Soc., no. 5, June 1927, p. 28.

[10] Proc. U. S. Nat. Mus., vol. 75, Art. 1, p. 10, 1929.

Three males (summer pelage), one male and one female (both in winter pelage); Bam-po, Kankyo-hokudo, 50 feet, north Korea; September 28–October 30, 1929.

Characters.—Similar in winter pelage to *Crocidura lasiura* and *C. thomasi*, but back more brownish than in the former and less so than in the latter; practically intermediate in color between the above two forms; in the summer pelage, the present species is much more brownish than in *C. lasiura*; not grayish. Abdomen delicate gray in summer, as in *C. lasiura*, and mouse gray in winter, as in both forms just mentioned. Older individuals attaining a greater size than in the other forms. The summer pelage is browner on the back than in the winter dress. Hands and feet dark brown; tail tipped with a tuft of hairs.

Measurements (in the flesh).—

NUMBER	SEX	HEAD AND BODY	TAIL	HIND FOOT	EAR
					mm.
49	♂	103	46	17.5	8
55	♂	82	37	15	9
61	♂	90	37	15	9
74	♂ old	105	48	16	9
99 (type)	♀ old	112	44	16.5	9

Skull measurements.—Greatest length, 23.5–25 (type); condylobasal length, 25 (type); greatest breadth, 10–11 (type); interorbital breadth, 5.5 (type); front of i^1 to back of m^3, 10.5 (type); tip of i^1 to tip of p^1, 5.5 mm. (type).

Howell (loc. cit.) has recorded one male from Sungaree River, Manchuria, under the name of *Crocidura lasiura*. This specimen has the length of head and body, 104; tail, 48; hind foot, 16.5 mm. This is undoubtedly identical with the present species, as the dimensions given by him are closely similar to those of the older specimens in the series.

The following species not represented in the Yamashina collection may be conveniently described here.

Crocidura neglecta, sp. nov.

Japanese: Hokusen-jinezumi

Type.—Adult male, N. Kuroda collection, no. 988.

Coloration.—The male (summer pelage) secured at Bam-po, north Korea, in September, shows that the coloration is exactly similar to that of *Crocidura lasiura* in summer; but the animal is noticeably smaller. Tail all around, black; under side slightly lighter, with bristles from median to basal parts only, and less numerous than in *Crocidura coreae*; tip slightly pencilled. Hands and feet blackish brown.

Measurements.—Head and body, 65; tail, 32; hind foot, 13; ear, 8. Skull: Greatest length, 20; condylobasal length, 19; greatest breadth, 8.5; interorbital breadth, 4.5; front of i^1 to back of m^3, 9; tip of i^1, to tip of p^1, 5. Nearly the same size as *Crocidura coreae*; but the dimensions of the skull are noticeably larger.

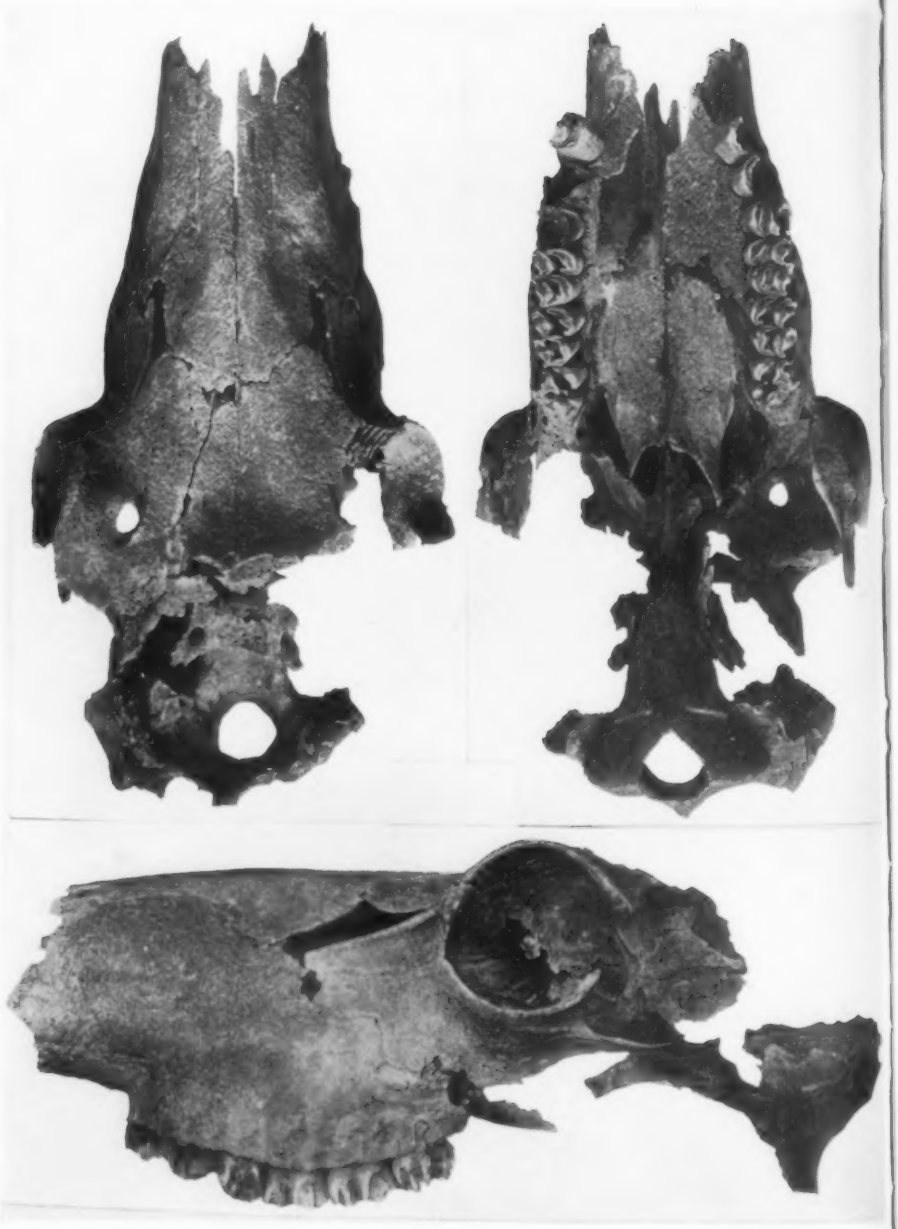
Family TALPIDAE

Mogera wogura coreana Thomas

Japanese: Chôsen-mogura

Two unsexed skins; Chian Zen, Kogendo, 300 feet, east Korea; July 23, 30, 1929.

Measurements (in the flesh).—Head and body, 129, 146; tail, 17; hind foot, 17, 18 mm.



SKULL OF RANGIFER CONSTANTINI

1. Upper view, 2. lower view; 3. side view

Skull (no. 10, broken): Greatest length, 35; basilar length, 30; greatest breadth, 17.5 mm. Index number of skull, 622. The type of *coreana* has an index number 682, so that the present specimen is smaller.

Family VESPERTILIONIDAE

Myotis daubentonii ussuriensis Ognev

Japanese: Usuri-momojirokômori

One female; Non-sa-ton, Kankyo-hokudo, north Korea; August 18, 1929.

Measurements (in the flesh).—Head and body, 47; tail, 37; ear, 14; forearm, 36.5 mm. Skull: Greatest length, 13.5; condylobasal length, 13.4; zygomatic breadth, 8 mm.

Membrane inserted at middle of metatarsus. Tragus sharply contracted at apex. Above dark brown, hairs slightly tipped with buffy, without slaty bases; below grayish-white, with slaty bases to the hairs.

Eptesicus nilssonii (Keyserling and Blasius)

Japanese: Heme-horikawakômori

Two males, one female; Bam-po, Kankyo-hokudo, 50 feet, north Korea; September 22–October 5, 1929.

Measurements (in the flesh).—Nos. 40 (♂), 58 (♂), 59 (♀), respectively: Head and body, 60, 63, 61; tail, 38, 38, 37; ear, 15, 18, 17; forearm, 42, 42, 42 mm.

Skull measurements.—Greatest length, 15–15.5; condylobasal length, 14–15; zygomatic breadth, 9–9.5 mm.

Muzzle and ears black; wings dark brown; back dark brown, hairs with pale buffy tips; hairs of underparts dark brown with more distinct buffy tips, so that the entire under side appears buffy.

Fukuyoshi Cho, Akasaka, Tokyo, Japan.

A NEW PALEOLITHIC REINDEER FROM SIBERIA

By Constantine C. Flerov

[*Plate 8*]

In 1928 the geologist M. Gerassimov found many remains of reindeer in paleolithic deposits of Solutrean age near Malta, a village on the White River, 80 kilometers northwest of Irkutsk, Siberia. In its cranial characters this reindeer is very different from all the hitherto known Eurasiatic species. It bears some resemblance to the Labradorean *Rangifer caboti* G. M. Allen.

Rangifer constantini new species[1]

Type.—Male (?) skull, in moderately good condition but lacking the intermaxillary bones and part of the braincase. Collection of the Quaternary Department, Geological Institution, Acad. Sci. U.S.S.R.

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[1] I give this name in honor of my father, Professor Constantin Theodor Flerov.

Age.—Solutrean.

Locality.—Environs of Malta, a village 80 km. northwest of Irkutsk, Siberia.

Diagnosis.—Skull very narrow and elongated; nasal bones very much arched; rostrum high and narrow, its height much greater than its breadth as in *Rangifer angustirostris* Flerov. The skull is very narrow in front of the orbits; palate similarly narrow, somewhat as in *Rangifer caboti* G. M. Allen. Molar teeth larger than in any other known recent reindeer. Dorsal profile of rostrum nearly straight. Upper part of braincase rising a little above the upper nasal level.

Measurements of *Rangifer constantini*, *R. angustirostris* and *R. arcticus*, respectively: Interorbital breadth, 108.6, 135.5, 126.6 mm.; zygomatic breadth at lower edge of orbits, 148.5, 184.4, 170.4; breadth between upper lacrymal foramina, 108.8, 133.9, 126.6; distance between supraorbital foramina, 68.3, 82.9, 78.9; breadth of rostrum at front edge of nasals, 59.1, 70.9, 69.5; height of rostrum at front edge of nasals, 67.3, 72.6, 65.5; distance between the front edges of lacrymals, 59.9, 77.1, 75.5; breadth of skull over second molar, 101.8, 117.1, 109.9; length of nasal bones, 116.7, 114.0, 116.0; greatest breadth of nasal bones, 51.8, 49.1, 66.6; least breadth of nasal bones, 23.9, 35.8, 26.2; distance between opposite alveoli of pm^2, 38.8, 62.7, 55.8; distance between opposite fore edge of alveoli of m^2, 54.7, 73.7, 63.4; length of cheek tooth row (alveoli), 101.1, 89.0, 79.6; breadth of palate over posterior nasal foramen, 35.6, 46.0, 39.1; length of pm^2 at base of crown, 14.4, 13.0, 12.1; length of pm^3 at base of crown, 15.0, 14.2, 12.8; length of pm^4 at base of crown, 15.6, 13.6, 12.5; length of m^1 at base of crown, 17.5, 15.2, 14.1; length of m^2 at base of crown, 19.0, 16.1, 15.0; length of m^3 at base of crown, 19.9, 16.2, 15.7.

Zoological Institution, Academy of Science, Leningrad, U. S. S. R.

GENERAL NOTES

ANOTHER NEW GENERIC NAME FOR A SOUTH AMERICAN MARSUPIAL

In the May, 1934, issue of this Journal (vol. 15, no. 2, p. 154), G. H. H. Tate proposed the generic name *Cryptolestes* to replace *Orolestes* Thomas (Smithsonian Misc. Coll., vol. 68, no. 4, p. 3, 1917), which he found to be a homonym of a genus of dragonflies. I find that the name *Cryptolestes* is also preoccupied in Insects, having been used previously by Ludwig Ganglbauer as follows:

Cryptolestes (subgenus of *Laemophloeus* F. Laporte-Castelnau) L. Ganglbauer, Die Käfer von Mitteleuropa, vol. 3, pp. 606, 608, and 612, Wien, 1899. Coleoptera: Cucujidae.

For this genus of marsupials I therefore propose the name *Lestoros*, which retains the roots of the name originally given by Oldfield Thomas.

The genotype will now be known as *Lestoros inca* (Thomas).—Paul H. Oehser, *U. S. National Museum, Washington, D. C.*

HIBERNATING BATS IN MINNESOTA

On January 4, 1934, William Wilber and the writer found approximately 150 big brown bats (*Eptesicus fuscus fuscus*) and a few little brown bats (*Myotis lucifugus lucifugus*) hibernating in a cave about two miles south of St. Peter, Minnesota, in the valley of the Minnesota River.

The cave was about 6 to 8 feet high, about equally wide and extended approximately 150 feet back through laminated sandstone which was easily broken with sticks. Crev-

ices in the ceiling contained about a third of the bats, from one to six or eight bats in each crevice. A few were hanging singly from the ceiling, and the rest were found in big masses clinging to each other and to the ceiling where the unevenness provided a right-angled recess. The largest of these masses occupied about one and a half feet of such a corner; and the bats were four to six layers deep in fairly regular lines. The layer nearest the corner apparently supported the greatest part of the weight of all, for the next layer clung to the first, the third layer clung chiefly to the second, and so on. Most of these masses were over a hundred feet from the entrance; but bats were found in crevices as close as ten feet from the entrance where it was possible to see several of them without the aid of artificial light.

We used sticks to loosen the bats from the wall and they fell to the floor protesting vocally but making no attempt to fly. About a hundred of them we carried in a hat to the entrance of the cave, where we dumped them out on the floor to examine them. After about 45 minutes here in the sun (temperature about 45°F.) some began to show more life and a few actually flew off. Fifty were taken and the rest were left in a small recess in the side of the cave. The temperature in the cave was about 40 degrees Fahrenheit.—CHARLES A. EVANS, *Museum of Natural History, University of Minnesota.*

NOTES ON BATS COLLECTED IN ARIZONA DURING THE SUMMER OF 1933

During the latter part of June and throughout the months of July and August of 1933 my wife and I collected vertebrates in southern Arizona. The records of some of the bats taken seem interesting enough to warrant their being reported here. The specimens mentioned are now in my private collection.

Choeronycteris mexicana Tschudi

Specimens collected: Peña Blanca Spring, Santa Cruz Co., 6, July 6–20; Miller Canyon, Huachuca Mountains, 8, August 13–18; Patagonia, 5, August 24.

We first saw these bats at Peña Blanca Spring, in the Pajarito Mountains, Santa Cruz County, in 1931, but were unable to obtain any specimens. Two years later, in the same crevice in "Castle Rock" near the spring, we succeeded in collecting a number of them. A noteworthy thing about these bats is that when they fly, they make a queer sound, which distinguishes them from the other bats of the region, except for the related species, *Leptonycteris nivalis*. After hearing this several times, I was able to tell, on entering a cave, whether this species was present or not. In my notes, I have described the noise as a loud flutter, which might be likened to a faint rumble. This is the only bat species the eyes of which I have been able to shine with a flashlight. The reflection is surprisingly bright. When disturbed in a cave or tunnel, they fly about for a few minutes; then if not further frightened, they hang up on the ceiling. The hind legs are long, and when the bats hang, they resemble nothing so much as plums, hanging by the stems. In a small cavity far back in the crevice where I secured all of the Peña Blanca specimens, I found a female with a young bat hanging to her. She made little attempt to escape, when I reached for her. The young one was so firmly attached to the mother's teat, that the shaking which it got while being carried back in a sack did not dislodge it. Several other females collected in the crevice had milk in the mammae, but no other young were found.

In the Huachucas, these bats were found in old mine tunnels. Though we collected seven in this locality, we saw at least as many more that we could not get. Individuals of *Corynorhinus rafinesquii pallescens* were nearly always associated with them.

Several miles west of Patagonia, there is an old tunnel in the rocky hillside directly over the road. In the afternoon of August 24, I entered this tunnel, and as I did so, a bat flew out. Five others remained; these I collected. They were all of this species. All were adults, one a lactating female. The females must hide their young in crevices,

or get them out of the way somehow, for lactating females are much more abundant than young individuals.

Leptonycteris nivalis (Saussure)

Specimens collected: Fort Huachuca, 1, August 23; Patagonia, 1, August 25.

The first of the specimens listed above was collected several hundred yards from the west boundary of the Fort Huachuca Military Reservation in a natural cave which had been slightly enlarged by miners. It is near the Pyatt Ranch, in what used to be the Panama Mine. A number of these bats were seen, but only one could be collected. They resemble *Choeronycteris mexicana* very closely, both in flight and in their manner of hanging from the ceiling. The similarity extends to the specimens in hand, and the distinctness of this individual was not immediately realized.

The Patagonia specimen was collected in a tunnel from which five *Choeronycteris* had been taken the day previous.

Eptesicus fuscus subsp. (Peale and Beauvois)

Specimen collected: Peña Blanca Spring, Santa Cruz Co., July 8.

This specimen was found hanging in a mine shaft about one-half mile from the spring.

Corynorhinus rafinesquii pallescens Miller

Specimens collected: Peña Blanca Spring, Santa Cruz Co., 1, July 18; Miller Canyon, Huachuca Mts., 4, August 11–18.

All were found in mine tunnels and prospect holes.

Tadarida mexicana (Saussure)

Specimen collected: Nogales, 1, August 1.

A number of these bats were found also in a small hole in the top of the entrance to a cave in the box canyon a mile or so below the spring at Peña Blanca.—Berry Campbell, *Johns Hopkins Medical School, Baltimore, Maryland.*

BEARS IN ESTES PARK, COLORADO

While spending the summer at Fern Lake Lodge in Estes Park, I had the opportunity to see bears in the wild state. Very few places are left at the present time where man can see animals which are truly wild. Every time that I saw one of these bears it was about dusk, except that once they came quite close to the Lodge, probably in search of food. They were dark brown, almost black. I never saw more than two together at any time. One bear, presumably the mother, was very large, and the others somewhat smaller.

Many times during the summer the bears broke into the kitchen. They were very fond of berry pies and often ate three or four in an evening. One night they knocked the flour bin over and spilled flour all over the kitchen. What they didn't eat of the food they spoiled beyond redemption. They would get their feet into jam and leave tracks that were very hard to scrub off of the floor. Many attempts were made to keep the bears out of the kitchen, for the cook was becoming quite disgusted. They would break the windows and tear the screening off. The owners considered barring the windows, but decided it was useless because the bears, if they smelled food within, would tear out the bars or knock down the door. At Bear Lake Lodge they have the kitchen wired so that the bears will get an electric shock and thus be driven away.

In winter the bears seem to take the Lodge for their winter quarters. In spring, when it is opened up, the kitchen is a very unsightly place. The bears have knocked everything off of the shelves and eaten all available food.

The den of these wild bears has been searched for every year, but in vain. I know of no other place where wild bears can be seen anywhere around here except at and near Fern Lake.—Dorothy Welch, *University of Colorado, Boulder, Colo.*

SOUTH AMERICAN CANIDAE

On page 50, Journal of Mammalogy, February, 1934, following a very interesting discussion of the South American Canidae, Dr. W. H. Osgood writes: "It is only to be regretted that there is no formal designation for the group as a whole, since it is scarcely of subfamily rank and can only be referred to awkwardly as 'the South American Caninae.'"

I venture to suggest that this is a good time to introduce the Tribe, as used by many entomologists (see especially the writings of Ashmead), a category below the subfamily, the name ending in *ini*. Thus we should divide the American Caninae into (1) Canini, type *Canis* L. and (2) Chrysocyonini, type *Chrysocyom* H. Smith. *Chrysocyon* has priority of place over *Dusicyon*, and is the more distinct genus. The form Canini was used by G. Fischer as early as 1817, but was not intended in the restricted sense now proposed.—T. D. A. Cockerell, *University of Colorado, Boulder, Colorado.*

FOOD HABITS OF PREDATORY MAMMALS

The following paragraphs review three important papers on the food habits of certain predatory mammals in Russia and compare them with results obtained in the United States.

1. Winter food of some predatory mammals, by N. D. Grigorieff, V. P. Teploff, and V. I. Tichvinsky, Records Volga-Kama Biologic-Trade Station, 1 (a) 1931, pp. 91–125.

General discussion in Russian, tabulation in Russian with scientific names, and summary in Esperanto. The tabulation gives the number of records of each kind of food and the percentage of occurrences of each item among those of all items. For *Vulpes vulpes* the most noteworthy foods are mice (100 records), hares (29), and birds (10); for *Martes martes*, mice (14), squirrels (4), and birds (9); *Mustela eversmanni*, spermophiles (2), mice (14), fishes (7), and moles and hedgehogs (2 each); *Mustela putorius*, mice (122), hares (8), moles (5), shrews (4), birds (31), snakes (3), frogs (34), toads (5), and fishes (20); *Lutreola lutreola*, mice (34), spermophiles (2), frogs (10), and fishes (50); *Kolonokus sibiricus*, mice (19), moles and shrews (4), birds (3), frogs (3), and fishes (8); *Mustela erminea*, mice (194), moles, hedgehogs, and shrews (33); birds (3), frogs (3), and fishes (22); and *Mustela nivalis*, mice (64), moles and shrews (18), and birds (2). In each case sundry vegetable foods are listed but they do not seem to be of importance.

The total number of records of the different classes of animal food for the eight species of predators are: squirrels, 4; spermophiles, 6; rat, 1; mice, 556; hares, 33; moles, hedgehogs, and shrews, 76; larger carnivores, 9; birds or their eggs, 63; reptiles, 4; amphibians, 76; fishes, 125; and insects, 18.

2. Food of the fox (*Vulpes vulpes* L.) in the Tartar Republic, by I. V. Jarkoff, V. P. Teploff, and V. I. Tichvinsky, Records Volga-Kama Biologic-Trade Station, 2, 1932, pp. 90–109.

This paper is based on investigation of the contents of alimentary tracts and feces, and of food remains found near dens, the results being described in the text and set forth more graphically in twelve tables. The text is in Russian but there is a summary in English. The principal winter foods (1930–1931) are mice, found in 24 out of 32 cases, hares in 15, and birds in 9; comparative figures for two other seasons are similar. A study of 48 feces of adult and 94 of young foxes reveals only moderate differences in feeding habits, the young taking about one-third more insects. In both groups small mammals predominate, insects are second, and birds third in rank. Comparison between winter and summer foods show, in percentages of occurrences in the food representations examined, hares 37.5 to 4.2; mouse-like animals 75 to 82; and insects 1.4 to 43. A comparison is given also of the summer feeding habits of the fox in forested country and in the steppe. In the latter region fewer mice, but more hamsters and

hares are consumed. In the steppe the adults ate more mice, hamsters, and hares, and the young more insects and birds. A summary of all occurrences of food items in the various classes of material examined shows 250 records for mice, 64 for hares, 89 for spermophiles, 147 for hamsters, 57 for birds, and 90 for insects.

3. Food of the badger (*Meles meles* L.) in the Tartar Republic, by J. V. Jarkoff and V. P. Teploff, Records Volga-Kama Biologic-Trade Station, 2, 1932, pp. 110–124.

Representations of food, including feces, remains found about burrows, and contents of alimentary tracts, totalling 472, were analyzed and the data presented in nine tables. According to number of occurrences in the total analyses, the following groups lead: Insects 364, Muridae 234, Anura 41, hamsters 20, birds 11, and moles and shrews 6. The authors conclude that the badger is a useful animal under conditions existing in the Tartar Republic. It destroys some birds' nests and devours some useful insects and the young of certain economically valuable creatures (?*Sciurus*, *Talpa*, *Tetrao*, *Tetrastes*), but the authors state it cannot have any marked influence on the numbers of these species. It is, furthermore, not at all harmful to the cattle industry nor to forestry.

Upon looking over the papers here briefly abstracted, the reviewer was struck with the similarity of the results to those obtained by Ned Dearborn[1] in Michigan. At least eight of the nine species of Russian predatory mammals reported on have food habits preponderantly tending in the right direction from an economic point of view, and the same is true of seven of the nine Michigan species published upon by Dearborn.

To one acquainted with economic ornithology, the situation with reference to predatory mammals in general seems much the same as we find in birds. Only a few of the species can justly be classed as chiefly injurious, and the others under ordinary conditions do more good than harm. This is inevitable from the very nature of predator-prey relationships. The flesh eaters must subsist either directly or indirectly upon the vegetation consumers. Man's crops are chiefly vegetable, hence these vegetation consumers include most of the creatures regarded as pests. Any predator upon them is in some degree man's ally. When animal crops are involved, predators may become injurious but this is a special case. It should be recognized that in Nature nearly all predacious creatures tend to be beneficial from man's point of view, and control plans and practices should be based on this understanding.—W. L. McAtee, *Bureau of Biological Survey, Washington, D. C.*

[1] Foods of Some Predatory Fur-bearing Animals in Michigan, Bull. 1, School of Forestry and Conservation, Univ. of Michigan, 1932, 52 pp., 22 charts.

EXTERNAL CHARACTERS OF NEWBORN POCKET GOPHERS

Three very young pocket gophers (*Thomomys bottae*) were found by Mr. D. H. Kelliker in a nest dug up at Richmond, Contra Costa County, California, April 4, 1933. Two were brought to the Museum of Vertebrate Zoology, where they were placed at my disposal in connection with an anatomical study of the pocket gopher now in progress.

The animals compare closely in size and development with full-time fetal specimens of the same species, and further, from the fact that the umbilical cord is still attached (only a small piece in one, the complete cord and part of the placenta in the other), it seems probable that they were not much more than about a day old.

The body resembles that of the adult in general fusiform shape, without a noticeable cervical constriction. The cervical flexure is more acute, while the lumbo-dorsal arch is more gradual and uniform than in the older animals. The two specimens had almost exactly the same measurements, namely: Crown-rump length, 36 mm.; total length, 49.5 and 50.5; tail length, 9; length of hind foot, 6; length of head, 14; width of head, 10;

length of upper arm, 6.5; length of lower arm, 7.2; length of thigh, 7; length of lower leg, 5.8; weight in grams, 4 and 4.2.

The body is covered with a pigmentless, wrinkled and loose skin, through which the eyes, bones, and even muscles can be distinguished. Scattered over the body are small papillae, from which fine colorless hairs protrude for a fraction of a millimeter. The vibrissae are considerably larger than the other hairs, and are similar to those of the adult, and indeed of most rodents (Pocock, R. I., Proc. Zool. Soc. London, 1914, pp. 901 ff.). There are numerous, well developed mystacials; fewer and finer submentals; two supraorbitals; two genals, but no interramals. In the absence of this last tuft there is an indication of specialization, since the more primitive forms have it. The genal vibrissae arise from a sensory swelling between the eye and the ear.

Compared with that of the adult the head is relatively larger and more ovoid, with the cranial region strongly arched in dorsal profile. The rostrum is short and broad, and the interorbital distance much greater than it later becomes. The rhinarium is like that of the adult, but with a more shallow internarial groove. It is separated from the division of the upper lip by a naked area in which the philtrum is visible. These features are present in the 18 mm. fetus and are probably of considerable significance. They are similar to conditions in *Microtus* (late fetus) and *Scirtopoda*, the latter figured by Parsons (Proc. Zool. Soc. London, 1922, p. 662, fig. 30). The upper lip is deeply notched, and its palatal lobes are rudimentary, as in the more typical rodents. The teeth are not yet erupted, and the triangular mouth opening is filled by the large tongue. The eyes are relatively larger than in adults but are still closed, the upper and lower lids being separated by a shallow groove. The ears are poorly developed, small swellings marking the rudiments of the typical parts of the mammalian ear. The cheek pouches, in shape and relations, are much as in the adult, but are somewhat smaller in proportion. They are quite well developed in the 18 mm. fetus, infolded from the skin lateral to the corners of the mouth.

The limbs are relatively short, and only the lower segments are free from the body skin. The forefeet are short, and are roughly pentagonal in ventral view, with the digits arranged around the anterior angle. The middle digit is the longest, and it is axial. The pollex is smallest and is separated from the rest by a noticeable interval. In the hind foot the digits are more nearly equal and are arranged in a horseshoe-pattern around the anterior end. The claws of both feet look somewhat like the hoofs of an artiodactyl, and are smaller in the pes than in the manus. Two well marked carpal pads, over the pisiform and falciform cartilages, and two small metatarsal pads on the sole, are present. The tail is constricted at the base, as in the mole (*Scapanus*), and ends in a peculiar peg-like structure. This latter is present in the fetus of the pocket gopher, and also in that of *Microtus*, and may represent a tail bud.

Both animals are males, as was determined by dissection, but the external genitalia when first examined appeared to be little more differentiated than in the human embryo of about 20 mm. This appearance is apparently due to the developing preputial glands at each side of the glans penis, which form swellings that simulate the labio-scrotal folds. At the base of the tail there are two other swellings, and immediately in front of these is the transverse anal aperture.

Certain external features of the adult appear early: the cheek pouches; the loose integument; general shape; the vibrissal pattern; and the features of the rhinarium. Others show regression during development: the relative size of the eye; and the peculiar tail structure. A third class consists of features which are developed after birth: the flattened dorsal profile of the head; the constriction of the interorbital region; and the fusion of the palatal lobes behind the incisors. These are, of course, only a few of the characters that may be so grouped.—JOHN ERIC HILL, *Museum of Vertebrate Zoology, University of California, Berkeley, Calif.*

A BLACK-EYED WHITE PEROMYSCUS

A black-eyed white old-field mouse, *Peromyscus polionotus polionotus*, was sent to me a short time ago by Harold J. Coolidge, Jr. Through the kindness of the Mammal Department of the Museum of Comparative Zoölogy the specimen has been deposited in the Museum of Zoology, University of Michigan. This mouse was found August 1, 1933, by Oliver Allen, a nature instructor, at the camp of the Athens Y. M. C. A., at Tallulah Falls, in northeastern Georgia. The animal was preserved by Mr. Allen, and, through H. A. Carter, was sent to the Museum of Comparative Zoölogy. The specimen is in alcohol, except that the skull has been removed for identification.

The pelage of this mouse is entirely white, with no trace of color anywhere. The feet, tail, and nose also lack pigment. However, the eyes, eye-rings, and outer part of the ears are black.

In the house-mouse and in some other domestic animals the black-eyed white character is inherited and it would likely prove to be inherited in *Peromyscus* also, if any of these black-eyed white animals could be secured alive.—Lee R. Dice, *University of Michigan, Ann Arbor, Michigan.*

ANOTHER RECORD OF THE FOSSIL VOLE MIMOMYS PRIMUS (WILSON) FROM CALIFORNIA

In May, 1932, issue of the Journal of Mammalogy, (p. 150) Robert W. Wilson described a new genus and species of fossil vole, from the Upper Pliocene of California, under the name *Cosomys primus*. This was the second record of the occurrence of this group, as fossil, in North America. In the following issue of the Journal (August, 1932, p. 280) Martin A. C. Hinton, noted British authority on the Microtinae, published a note in which he stated that the genus *Cosomys* was identical with the European fossil genus *Mimomys*.

A month after Wilson's account had appeared, W. F. Barbatt sent to the Museum of Paleontology, at Berkeley, the tiny lower jaws of a fossil vole. This specimen was presented to the Museum by the Standard Oil Company of California, through the courtesy of Mr. G. C. Gester. It was collected by Barbatt from a green shale in a rotary drill core, which had been taken from the "Crites" no. 1 well, Buttonwillow Gas Field, Kern County, California. The elevation of the casing head was 298 feet, and the core, at the point from which the specimen was taken, was 3174 feet below the surface.

These lower jaws belong to the same form as that described by Wilson, but our material is less complete. Upon the evidence of Hinton, the name for this animal would be *Mimomys primus*, the specific name being retained on the slightly more primitive character of M^3 over that of the European *M. pliocaenicus*. Although this crucial part is not present in our specimen, in other respects it is quite the same as *M. primus*.

On the basis of invertebrate faunal zones located some distance above the level of this specimen, the shales in which it occurs are referred to the Upper Etchegoin formation. Stratigraphically it would appear to be either Upper Pliocene or early Pleistocene, the vole jaws being very close to the boundary. Fortunately Wilson's species was associated with a small mammalian fauna which places its age as Upper Pliocene.—Curtis J. Hesse, *Museum of Paleontology, University of California, Berkeley, California.*

WILD AND DOMESTICATED ELK IN THE EARLY DAYS OF FRANKLIN COUNTY, INDIANA

Several persons who knew the liking of my father, William Wallace Butler, for animals have asked me to write about his captive elk.

These animals, *Cervus canadensis canadensis*, were comparatively rare in Indiana at the time of its settlement by white people. They evidently had been more numerous before that time. But they and the bison had largely disappeared before the pioneers occupied the land. My grandfather, Amos Butler, bought a young elk (wapiti) which

was caught in the valley of Laughery Creek, within the present limits of Ripley County, before 1810. Henry Berry, an attorney of Brookville, told me when he was young he frequently saw their antlers on the riffles and sandbars of the Whitewater River. The remains of these animals are still occasionally found throughout this state. I had an antler taken from the banks of Big Cedar Creek in 1881, and I still have one taken from Yellow Bank Creek, both in Franklin County, Indiana.

One of my earliest recollections is of the "elk lot." It was so known by the neighbors and was a triangular tract adjoining the north corporation line of Brookville, Indiana, in the forks between the old Connersville road and the turnpike to that place. It was west of the road, in front of the "old brick house" built by my grandfather, Amos Butler, about a hundred and twenty-five years ago. On the east side was a high post and rail fence such as are found in eastern Pennsylvania and Maryland. The post axe was among the tools in our woodhouse up to about 1880. The other two sides had high "worm" (rail) fences with "stakes and riders." In this lot the elk were usually kept. I have often heard my father speak of them and of his experience in trying to domesticate them; to break them to harness and teach them to drive to a sleigh.

Another evidence of the elk was a considerable number of antlers in our barn; most of them were single but one pair was united to the front of the skull. These were used by my mother to put over her flowers to keep off dogs and other intruders. She assured me these came from our elk. They were all destroyed when our barn burned about 1872. If my recollection is correct my father spoke of having more than three elk, perhaps five or six. Also that at least one of them was butchered and eaten by our family and friends.

In trying to recall some one who would know about these animals my mind turned to Wm. C. Lynn, a native of Brookville, but now at the age of almost 94 years, living in Indianapolis. He remembered them and an experience he had with them when he was about fifteen years old. He says: "Your father brought in three tame elk. Harness was fitted on them and a lot of us tried to break them to a sleigh in the old fair ground adjoining Brookville College, now the Public School. The attempt was unsuccessful. They ran away with us, dumped us into the snow and broke up the sleigh. Those who were with me in this attempt were Thomas C. Sheperd, Benjamin McCarty, William H. Berry and my brother, James Lynn. I did not know the history of these animals. I do not think they were vicious. Your father had the harness, of strong leather and breast style, made in Brookville. There was not much trouble in placing the harness on the animals or in attaching two of them to the sleigh but when the start was made it was a dash and a catastrophe to the sleigh. The elk were recaptured and placed unharmed in your father's barn."

To verify my recollection I sought my father's diaries. They show he visited, for about ten days in August, 1857, his brother-in-law, Rev. D. D. McKee, a Presbyterian minister at Marion, Iowa. There he bought three elk and spent five or more days in breaking them. He drove them as cattle are driven to St. Louis and took them on the steamboat "Arizona," August 17, arrived in Cincinnati, August 24, whence they were taken to Brookville. October 2 is noted, "Last day of the County fair. Awarded, on elk, premium $5.00." And next the record is, "Fixing around fairground to keep elk in."

February 13, 1858 he wrote, "Fixed up sleigh and hitched up my elk. Done very well. Had one run away, hurt me a little."

May 6 following he "Bought 3 elk of Thomas Mitchell for one hundred dollars." He then had six elk. Four of them died that summer and he saved the skins and had them tanned by R. P. C. Barwick.

June 20, 1859 is recorded: "Took my doe elk to upper pasture to have a young one."

In 1860, April 13, he notes: "Elk lost his horns."

April 14, 1861 the elk shed its horns. The last elk was slaughtered March 8, 1862.

Summing up:

Elk were formerly found in Indiana, as shown by early records and by their remains. They disappeared soon after the beginning of white settlement, probably about 1810, in southern Indiana, but in a record of animals found at the Indian Agency office near Ft. Wayne, January 20, 1818, the elk is listed. Mr. O. M. Meyncke presented to the Brookville Society of Natural History some fifty years ago a beautiful set of elk antlers obtained by him some dozen years before in Madison County, Nebraska. Can we measure their recession by these dates: The last in Indiana, 1818; Iowa, 1857; Nebraska, 1870? Is the middle of April the regular time for the elk to shed antlers in this latitude? Is not June 20 late to expect them to fawn? They may be partially domesticated. To be driven (herded) like cattle, from Marion, Iowa to St. Louis, loaded on a steamboat for a week's trip to Cincinnati and there driven to Brookville, Indiana indicates that.—Amos W. Butler, *52 Downey Ave., Indianapolis, Indiana.*

CAPTIVE PIGMY ELEPHANTS IN AMERICA

On April 4, 1925, there arrived at the Philadelphia Zoological Garden a fine specimen of pigmy elephant. This was the third of this much discussed species to arrive in America. The animal was purchased as an *Elephas africanus*, and we were somewhat surprised when it was found to be a specimen of the rare *Elephas cyclotis* Matschie, of which comparatively little was known. The height of this species it is said is limited to under seven feet. Our specimen upon arrival measured but three feet, six and one half inches, and weighed 550 pounds. She was estimated to be about two and one half years old. Her neck circumference was three feet, nine inches. For the first three or four years she made unusually rapid gains in growth, as shown by the following table:

Year	*Height at shoulder*
July, 1925	3 feet, 6½ inches
July, 1926	4 feet, 7½ inches
July, 1927	4 feet, 10½ inches
July, 1928	5 feet, 3 inches
July, 1929	5 feet, 6½ inches
July, 1930	5 feet, 8½ inches
July, 1931	6 feet, 2½ inches
July, 1932	6 feet, 4 inches
July, 1933	6 feet, 6 inches
December 13, 1933	6 feet, 7 inches

This shows the rapid first growth and gradual tapering off as she approaches full size.

The tusks on this female have made rapid growth, having already reached the length of 22 inches, with a six inch circumference at the base. They have a decided inward turn. The trunk is very short, measuring but 36 inches with a circumference at tusks of 31 inches. The ears measure, from top to tip of lobe, 30½ inches, while the width is but 22½ inches. Unlike *Elephas africanus*, *Elephas cyclotis* has five toes externally visible on the front feet and four on the hind.

There has been considerable controversy regarding the standing of *Elephas cyclotis*, many naturalists considering it a subspecies. Dr. Thomas Barbour, Director of the Museum of Comparative Zoölogy at Harvard College, in a recent letter, said "there is no doubt whatever that this is a perfectly distinct species." He further states, after studying at great length with Dr. Glover M. Allen some recent photographs of our specimen and comparing them with specimens and photographs of elephants from other parts of Africa, that Dr. Allen was completely won over to his way of thinking. Dr.

Allen has always maintained that these little West African elephants are small because of the fact that trade in ivory has gone on longer in this part of Africa than anywhere else, and that the killing of big bulls generation after generation had resulted in the production of a depauperate race.

The first pigmy elephant to arrive in America was purchased by the New York Zoological Society. Dr. William T. Hornaday's description of it in "Tales from Nature's Wonderlands" (pp. 223–225), is as follows:

"During the last two centuries—not to weary ourselves by going farther back—thousands of white traders, hundreds of white officials, hundreds of missionaries, scores upon scores of hunters and animal dealers and probably half a hundred 'professional' naturalists have worked the West African coast on both sides of the Equator, for a total of 200 miles or more inland, without ever collecting or even recognizing a pigmy elephant. The white nationalities represented have been English, French, German, American and Belgian.

"The traders have bought and exported ivory elephant tusks in quantities formerly great, and we know that thousands of the queer-shaped and tiny tusks of the pigmy were part of that loot from the jungle. But, one and all, they never developed the fact that a *small species* of elephant was represented. Ivory hunters, sportsmen and explorers—and, sad to say, some naturalists also have gone elephant hunting and killed many elephants without having the eyes to see the small round ears, extra toes and miniature tusks of the pigmy species. No. For two centuries a wonderful undescribed elephant actually thrust itself under the eyes of all those people, who should have noticed, without having been understandingly seen at all! It was a carnival of heedlessness.

"At last the redoubtable Carl Hagenbeck appeared upon the scene. I never learned what impelled him to send out men to catch elephants in West Africa, but it was his men who captured the first pigmy elephant that ever came into a zoo. When it finally landed in Hamburg, a German naturalist, Professor Noakes [= Noack, Zoöl. Anzeiger, vol. 29, p. 631, January 8, 1906], saw that it represented a new and undescribed species, and he described and christened it with the Latin name of *Loxodonta pumilio*. [*Elephas africanus pumilio* was the name employed by Noack. Ed.] That very type-specimen animal was immediately purchased by our Zoölogical Society, and brought to New York.

"It being a male, we named him "Congo", and he lived with us for ten years. He grew to maturity. When fully grown his height was 6 feet 8 inches, and his weight was 2,700 pounds. His tusks were 23½ inches long outside the lip, and no thicker than a lady's wrist. Finally he contracted an incurable leg disease, and died. Judging by the number of years it took him to reach maturity, he should have lived about forty-five years.

"Aside from its pigmy size, which is limited to a height under 7 feet, the most noticeable different feature of this new elephant species is its small and round ears. It will be remembered that other African elephants have ears that are enormously large, and triangular in shape. The Pigmy has [externally visible] five front toes and four hind toes, which is one more on each foot than the number allotted by Nature to the big African elephants. Our "Congo", the type specimen, died in July, 1915. . . . ."

His remains were presented to the American Museum of Natural History, where his skin and skeleton are preserved for mounting.

"Tiny", another pigmy elephant, was received in the New York Zoo on December 6, 1922. He was believed to have been born in 1920. Upon arrival, his height at the shoulder was three feet two inches, and his weight was 425 pounds. When he died in March, 1933, his weight was 2045 pounds, and the last measurement taken in June, 1932, was five feet, ten inches.

The oldest name for this animal and the name now used is *Elephas cyclotis* Matschie[1]; the type specimen is in the Berlin Museum.

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[1] Sitz.-Ber. Gesellsch. Naturforsch. Freunde zu Berlin, 1900, p. 194.

Mr. Edmund Heller, Director of the Washington Park Zoölogical Garden in Milwaukee, writes, in the bulletin of his society:[2]

"A third and very distinct species of elephant occurs in extreme western Africa, in Liberia (the land of the pygmy hippo) and eastward to the Kameroons. This elephant is also a pygmy of sorts and is usually known to the zoo public as the pygmy elephant. The name Pygmy will doubtless stick in the public mind and replace the older or first name bestowed on this species of round-eared or *cyclotis* given it by its original describer. The history of the name pygmy (*pumilio*) runs thus: In 1904 Carl Hagenbeck secured from Africa what he considered a pygmy elephant. At that time it was a mere baby (but was erroneously considered adult) three and one half feet high and weighing six hundred pounds. . . . . Wild killed males of this species often stand seven feet at the shoulder and weigh over three thousand pounds. They are known to science as *Loxodonta cyclotis* but to the public they will doubtless remain the pygmy elephant, because they attain only one-half the bulk or weight of the African elephant. The ear is very different in shape from that of the large African species, being circular in outline without the fold inwards at the neck and only half the size proportionately of the African elephant."

Our specimen "Josephine" is, I believe, at this time the only one in captivity in America. She is in excellent condition, very gentle and quite intelligent. She is being carefully watched and measured at intervals of six months to obtain exact data as to the tapering off as she approaches full growth. Daily during the summer months she takes her bath by picking up a hose and spraying herself, preferring this to going into the large tank used by the other elephants. In all the time she has been here I have never seen a sign of trickery or of a mean disposition. Now at the age of eleven years, I believe she has nearly reached the peak of her growth in height. Measurements taken December 13, 1933, were:

Height	6 feet, 7 inches
Length of tusk	22 inches
Circumference of tusk at base	6 inches
Width of ear	22½ inches
Height of ear	30½ inches
Length of trunk	36 inches
Circumference of trunk	31 inches

—C. Emerson Brown, *Philadelphia Zoölogical Garden, Philadelphia, Pa.*

A PIGMY SPERM WHALE FROM THE SAVANNAH RIVER ENTRANCE

On November 1st, 1929, I found a partially decomposed cetacean, about nine feet long, on the north side of the Long Island Fill, near the mouth of the Savannah River. This place is only a hundred yards across the line, in South Carolina. It is open to Callibogue Sound. The animal had either washed in across the sound, or had foundered on the mile wide mud flats.

No injury was apparent, but decay made it almost impossible to check up on the location of the fins, etc., so I was unable to identify it, or even to describe it sufficiently to Gerrit S. Miller, a week or so later in Washington, to obtain even a tentative identification.

Later I removed the skull, and not considering it of any value, left it exposed to the weather on the fill until after a conversation with E. B. Chamberlain, at the Charleston Museum, in June, 1930. As soon as possible after that the skull and badly shattered

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[2] Bull. Washington Park Zoöl. Soc., vol. 4, no. 1, pp. 11–12, May, 1933.

lower jaw were sent to Mr. Chamberlain, who at once identified it as a pigmy sperm whale (*Kogia breviceps*).

Jordan, in his "Manual of the Vertebrate Animals of the Northeastern United States", gives the range as "Warm seas, occasional on our coast", and Anthony, in "Field Book of North American Mammals", writes: "Has been taken at scattered localities along the Atlantic Seaboard, but is apparently a rare animal".—IVAN R. TOMKINS, *U. S. Dredge Morgan, Savannah, Ga.*

THE TYPES OF THE FOSSIL MAMMALS DESCRIBED AS AQUILA ANTIQUA AND AQUILA FEROX

In a recent paper,[1] in discussing certain fossil specimens in the collections of the American Museum of Natural History, I have indicated that *Aquila antiqua* (type of the genus *Minerva* Shufeldt) and *Aquila ferox* of Shufeldt are based on the claws of an edentate so that they are referred to the Mammalia. The types forming the basis of these two names are almost identical in appearance, being based on claws probably of the same species. Dr. Walter Granger writes me that on checking over the specimens on their return to him it has been discovered that the names on the labels of the two types in question were transposed, apparently at the time the fossils were originally catalogued. In my study, unaware of this error, I followed the labels so that in the paper cited my statements regarding *Aquila antiqua* refer to *A. ferox* and those on *A. ferox* to *A. antiqua*. This in no way affects the conclusion reached that both represent an edentate, but unless corrected may lead to some confusion later regarding these two types, the museum labels having now been corrected.

The type of *Aquila antiqua* is A. M. No. 5164, consisting of a nearly complete claw, only the point being broken away. It is light brown in color. The type of *Aquila ferox* is A. M. no. 5163, a claw with the point broken away. It is black in color and is accompanied by a median phalanx.—ALEXANDER WETMORE, *U. S. National Museum, Washington, D. C.*

A SIMPLE METHOD FOR SECTIONING MAMMALIAN HAIRS FOR IDENTIFICATION PURPOSES

The hairs of many mammals, while very similar when viewed longitudinally through a microscope, appear different and are readily distinguishable when the transverse aspects are compared. In fact, absolute discrimination of closely related genera almost always necessitates the consultation of cross sections. This investigator has found no other positive microscopical means of separating the hairs of *Microtus* from those of *Evotomys*; those of *Lepus*, *Sylvilagus*, and *Brachylagus* from those of *Ochotona*; and those of many other genera whose pelages do not present adequate diagnostic characters when the hairs are viewed longitudinally. It has been found advisable, therefore, before finality is expressed on the identity of an unknown hair sample, to subject it to transverse observation.

A method for the sectioning of hairs to be examined has been developed in the Food Habits Research Laboratory of the Biological Survey, and has been applied to many hair identifications made there. The method is simple and quick, and eliminates the uncertainty of results found in the paraffine block method. It is a modification of the old but successful "pith-razor-blade" procedure used so much in mycology for the sectioning of the softer fungi. A few of the hairs to be studied are paralleled to the longitudinal axis, and between the two halves of a piece of ragweed pith (or other pithy plant fiber) which has been split lengthwise. The halves are then sealed together with a

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[1] Wetmore, A., The Status of *Minerva antiqua*, *Aquila ferox* and *Aquila lydekkeri* as fossil birds. Amer. Mus. Nov. No. 680, Dec. 4, 1933, pp. 1–4, 1 fig.

small amount of gum-arabic mucilage, and the resulting whole set aside to dry. When dry, a sharp razor blade and a steady hand will enable an operator to cut sections of hair thin enough to be studied under any power of the microscope. The pith shavings may be trimmed sufficiently to permit the placing of several sections, serial or otherwise, in balsam under one cover glass.

This method has enabled the writer to section hairs of more than one hundred and fifty species, representing seventy genera of North American mammals, and to make drawing-ocular reproductions of them under oil immersion. Up to the present time only the general shape of the cross sections has been studied, but this has been enough to show that diagnostic differences do exist and that genera can be recognized from the shape of the hair sections. It is hoped that a more detailed study, especially of the relationships of the structural elements, will result in finding more data, which will in turn aid in further separations.—CECIL S. WILLIAMS, *U. S. Biological Survey, Denver, Colo.*

NOTES ON WISCONSIN MAMMALS

A recent examination of a series of pellets of the great horned owl (*Bubo virginianus virginianus*), collected in Wisconsin by P. L. Errington during the Coöperative Quail Investigation studies and examined in the Food Habits Research laboratory of the U. S. Biological Survey, has yielded some interesting mammal records for the state. It might be added that considerably more specific information along this line could be obtained if persistent and careful analyses of strigine pellets from particular localities were made.

Cryptotis parva. This shrew was encountered in pellets from two localities. A single individual was recovered from one of a lot of 6 pellets collected near Pine Bluff, one mile north of Klevenville, in Dane County, on January 31, 1932; and another was retrieved from one of a lot of 26 pellets gathered east of Prairie du Sac, in Sauk County, on February 21, 1932. The presence of this shrew in southern Wisconsin has been suspected, but these occurrences apparently represent the first records for the state. The skull of the specimen from Pine Bluff is now number 251113 in the U. S. National Museum, Biological Survey collection. The somewhat battered and fragmentary skull of the specimen from Prairie du Sac is in the mammal collection of the Milwaukee Public Museum.

Sorex arcticus laricorum Jackson. The skeletal remains of a single individual of this shrew were recovered from a fresh pellet collected, along with 23 others of varying ages, southeast of McFarland, near Lake Kegonsa, on April 11, 1931. With one exception, all previous records of this species for the state are confined to the northern counties. W. E. Snyder has reported a single specimen from Beaver Dam, in Dodge County, which locality has remained up to this time the southern outpost of the species. The present specimen from McFarland extends the known southernmost limits some 30 or more miles. The skull of this specimen is number 251134, U. S. National Museum, Biological Survey collection.

Mustela rixosa alleghenienses. Fur and skeletal fragments, including a nearly complete skull, of an Alleghenian least weasel were found in a pellet taken from the same series as that from which the above mentioned *Sorex arcticus laricorum* was retrieved, namely from one of a lot of 26 pellets collected southeast of McFarland, near Lake Kegonsa, on April 11, 1931. This diminutive weasel is probably more common in the State than the scarcity of records would seem to indicate. There are 7 specimens from Wisconsin in the Milwaukee Public Museum, and these to my knowledge comprise the majority of those that have been taken within the boundaries of the state. The skull of the McFarland specimen is in the U. S. National Museum, Biological Survey collection (no. 251114).

The accuracy of records reported from pellet analyses might be questioned on the grounds that the actual point of collection can not be determined, inasmuch as the prey is captured an unknown distance from the place at which the pellet is deposited and retrieved. While avian territorial studies have not advanced very far, there is some information to support the contention that in the case of the great horned owl the discrepancy in locality is not very great. The adult great horned owl is a sedentary fellow and in the face of a plentiful supply of food does not wander very far from his favorite perch.

The writer wishes to acknowledge the assistance rendered by Dr. Hartley H. T. Jackson of the Biological Survey in verifying identifications of the specimens reported upon.
—A. L. Nelson, *U. S. Biological Survey, Washington, D. C.*

EARLY FAUNA OF THE MONTEREY REGION, CALIFORNIA

There are many shellmound deposits of varying size in the Monterey region and some of these have yielded numerous bones of vertebrate animals, although the majority seem to contain nothing more than soil and the shells of invertebrates. The identification of the elements recovered give some indication of the vertebrate animals present at a relatively early date.

The species of mammals found in these deposits, associated with a marine habitat, are the California harbor seal, *Phoca richardii geronimensis*, the California sea lion, *Zalophus californianus*, and the sea otter, *Enhydra lutris nereis*. Both the sea lion and the seal are to be found along the coast at the present time, but the sea otter is extinct unless the occasional reports of fishermen may be credited. The mammal species that are land dwelling are not so well represented in the number of elements recovered as the first group. Those identified include the coyote, *Canis ochropus ochropus*, the brush rabbit, *Sylvilagus bachmani bachmani*, the pocket gopher, *Thomomys bottae bottae*, the striped skunk, *Mephitis occidentalis*, the southern black-tailed deer, *Odocoileus columbianus scaphiotus*, and the dwarf elk, *Cervus nannodes*.

Fish bones were collected but inadequate comparative material makes their identification impossible at present.

Of the birds the cormorants, *Phalacrocorax*, are represented by the largest number of elements. Other bird bones represent the common loon, *Gavia immer*, ducks and geese, pelican, *Pelecanus occidentalis californicus*, the California murre, *Uria troille californica*, the long-billed curlew, *Numenius americanus*, and many more the identification of which is uncertain.—Edna M. Fisher, *2410 Fulton Street, Berkeley, California.*

TWO MAMMAL RECORDS FOR SOUTH CAROLINA

A series of barn-owl pellets collected from two localities in South Carolina by E. B. Chamberlain, of the Charleston Museum, and examined in the Food Habits Research laboratory of the U. S. Biological Survey have yielded two interesting mammal records for the state, both of which are here reported upon.

Microtus pennsylvanicus. Two lots of pellets, numbering in all more than 60, taken in Charleston County near the Santee River on March 1, 1933, yielded, on the basis of a skull count, a total of 59 meadow mice (*Microtus pennsylvanicus*). To the knowledge of the writer there are no previously reported occurrences of this species for coastal South Carolina. The coastal subspecies *nigrans* has not been known to extend southward beyond northern North Carolina, while the subspecies *pennsylvanicus* is restricted in its southern distribution to the Piedmont. It would seem that *nigrans* would be most likely to occur in this Santee River area; however, this is a mere conjecture and it will, of course, be necessary to obtain skins to settle with certainty the taxonomic position of the specimens. In any event, the occurrence of *Microtus pennsylvani-*

cus in Charleston County represents a considerable southern extension of the known range of the species. The fact that the species represented the major item of food in the diet of the owl testifies to its abundance in this one locality.

Sorex longirostris longirostris. In a lot of 6 pellets taken on the Combahee plantation in Colleton County, on March 25, 1933, the fragments of this rare and locally distributed shrew were retrieved. Although the type specimen of this form is from coastal South Carolina, only the one specimen apparently has ever been taken in the state. The fragmentary skull of this shrew is now in the Charleston Museum.—A. L. Nelson, *U. S. Biological Survey, Washington, D. C.*

SIXTEENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The sixteenth annual meeting of the American Society of Mammalogists was held at The American Museum of Natural History, New York City, from May 8 to May 12, 1934. There were 94 members present, representing 14 states, the Canal Zone and Canada.

PROGRAM

Tuesday, May 8

8.00 *p.m.*

Meeting of the Board of Directors at the Hotel New Yorker

Wednesday, May 9

9.00 *a.m.*

Address of welcome. Roy Chapman Andrews, Acting Director, The American Museum of Natural History.

1. The economic status of the red fox in New York State. W. J. Hamilton, Jr.
   Discussed by V. Bailey, and W. E. Saunders.
2. Report of activities of the American Committee for International Wild Life Protection during the past year. Elisabeth Hone.
   Discussed by T. S. Palmer.
3. Note on the spring and fall molt of a weasel (*Mustela noveboracensis*) kept indoors. Charles V. Noback.
   Discussed by M. W. Lyon, Jr., and T. H. Evans.
4. Some notes on the food habits of foxes in New York State as determined by the New York State Ruffed Grouse Investigation. Gardiner Bump.
   Discussed by V. Bailey, and M. W. Lyon, Jr.
5. Present status of National Parks mammals and the restoration program. George M. Wright and Ben. H. Thompson.
   Discussed by Rosalie Edge, A. R. Shadle, H. J. Coolidge, Jr., T. S. Palmer, and Willard G. Van Name.
6. Men and mammals in joint occupation of National Parks. George M. Wright.
   Discussed by T. S. Palmer, M. W. Lyon, Jr., and H. J. Coolidge, Jr.

1.30 *p.m.*

7. The fur bearers of New York in relation to agriculture. W. J. Hamilton, Jr.
8. Local habitat of *Sorex cinereus*. David G. Nichols.
   Discussed by M. W. Lyon, Jr.

9. Dogs versus wolves in the east. H. E. Anthony.
Discussed by J. K. Doutt, H. H. T. Jackson, and M. W. Lyon, Jr.
10. Informal statement in regard to wild life policies. J. N. Darling.
11. Winter food habits of coyotes; a report of progress, 1933. C. C. Sperry. [Read by W. C. Henderson.]
Discussed by L. R. Dice, W. E. Saunders, and V. Bailey.
12. An aid to small mammal photography. Victor H. Cahalane.
Discussed by M. W. Lyon, Jr., and A. R. Shadle.
13. Better traps and better trapping. Vernon Bailey.
Discussed by H. J. Coolidge, Jr., and G. G. Goodwin.
14. The use of a dog in the operation of a live duck trap in Holland. Harold J. Coolidge, Jr.
15. Demonstration of the Fisher live traps for small mammals. Lee R. Dice.
16. Notes on the Humane Trap Contest. W. E. Sanderson.
Discussed by W. J. Hamilton, Jr., and V. Bailey.
17. On the occurrence of big game animals in the northeastern United States. George G. Goodwin.
Discussed by Morris Green.

8.15 *p.m.*

18. Studies of vampire and spear-nosed bats. Raymond L. Ditmars.
19. Home life of the beaver. Vernon Bailey.
20. Photographing wild animals at home by floodlight. Spencer R. Atkinson.

THURSDAY, MAY 10

9.00 *a.m.*

21. Preliminary notes on the nasal passages and associated structures in a beaked whale. H. C. Raven.
Discussed by T. S. Palmer, and W. K. Gregory.

(Joint session with the American Association of Physical Anthropologists)

22. Contribution to the study of the primate femur. A. Hrdlička.
Discussed by W. K. Gregory, and F. M. Ashley-Montague.
23. Variety in proportions among mammals, with special reference to man. Chas. B. Davenport.
24. A report of field studies on some new world primates. C. R. Carpenter.
Discussed by L. R. Dice, and H. E. Anthony.
25. Functional adaptations of the forelimb in the sloths as compared with certain other mammals. Ruth A. Miller.
26. The sequence of eruption of the permanent teeth in primates. Adolph H. Schultz.
Discussed by H. J. Coolidge, Jr., T. D. Stewart, and T. S. Palmer.
27. On "Williston's Law" of the progressive reduction in the number of primary skull elements from fish to man. W. K. Gregory and Marcelle Roigneau.
28. Digital epiphyses and carpal bones in a young male chimpanzee. Charles V. Noback.

1.30 *p.m.*

29. A method of preserving large teeth. Hartley H. T. Jackson.
Discussed by H. E. Wood, J. K. Doutt, and L. R. Dice.
30. Geographical variations in *Peromyscus maniculatus* from the Uinta Mountains, Utah. Harold J. Leraas.

31. Polychromatism in Hyraxes. Robert T. Hatt.
Discussed by G. H. H. Tate.
32. Two years in the Arctic with Peary. J. S. Warmbath.

4.30 *p.m.*

Annual Business Meeting of the Society

7.00 *p.m.*

The annual dinner of the Society was held at the American Museum of Natural History. After the dinner, which was held in conjunction with the American Society of Ichthyologists and Herpetologists and the American Association of Physical Anthropologists, Count Ilia Tolstoi showed motion pictures of coati mundis and mongooses attacking respectively iguanas and bushmasters. These pictures were followed by films of animals of Matto Grosso and an accompanying lecture by Sasha Siemel, "A Hunter's Day in Matto Grosso."

FRIDAY, MAY 11

9.00 *a.m.*

33. Water conservation in Dipodomys. I. Gersh. [Read by A. B. Howell.]
Discussed by V. Bailey, and M. W. Lyon, Jr.
34. Distribution of the red squirrel in Indiana. M. W. Lyon, Jr.
Discussed by F. Harper, C. E. Johnson, H. H. T. Jackson, A. Shadle, and R. T. Hatt.
35. Bats as food. Glover M. Allen.
Discussed by V. Bailey, H. E. Anthony, and F. Harper.
36. Notes on the range of the Florida water-rat. Arthur H. Howell.
Discussed by M. W. Lyon, Jr., V. Bailey, and F. Harper.
37. 30,000,000 year evolution and geographic distribution of the Proboscidea. Henry Fairfield Osborn.
Discussed by G. M. Allen, and M. W. Lyon, Jr.
38. Studies on the life history of the meadow jumping mouse, *Zapus hudsonius hudsonius* (Zimmermann), and the woodland jumping mouse, *Napaeozapus insignis insignis* (Miller). Carolyn Sheldon.
Discussed by V. Bailey, M. W. Lyon, Jr., and G. M. Allen.
39. Notes on the habits of the Mongolian wild ass. Roy Chapman Andrews.
Discussed by G. M. Allen and C. E. Johnson.
40. A résumé of tooth production in domestic rabbits. Albert R. Shadle.
Discussed by A. E. Wood.
41. Remarks on *Rattus* of the Pacific Islands. G. H. H. Tate.
Discussed by G. M. Allen.
42. The origin and evolution of *Hippopotamus*. Edwin H. Colbert.

1.30 *p.m.*

43. The phylogeny of the rhinoceroses, a case history in evolution. Horace Elmer Wood, II.
Discussed by A. R. Shadle.
44. The giant rhinoceros *Baluchitherium*. Walter Granger and W. K. Gregory.
Discussed by A. E. Wood.
45. The evolution of the pigs. Edwin H. Colbert.
Discussed by M. W. Lyon, Jr., H. C. Raven, A. E. Wood, W. B. Scott, and W. K. Gregory.

46. The phylogeny of the dogs. William B. Scott.
47. A marsupial from the Florissant beds of Colorado. C. Lewis Gazin.
    Discussed by W. K. Gregory, W. B. Scott, A. E. Wood, and G. H. H. Tate.
48. The phylogeny of the heteromyid rodents. Albert Elmer Wood.
    Discussed by M. W. Lyon, Jr., and W. B. Scott.
49. Late Cenozoic Mammalia from the Snake River Basin in Idaho. C. Lewis Gazin.
50. Artifacts associated with extinct mammals in North America. C. Bertrand Schultz.

4.15 *p.m.*

Final Business Meeting of the Society

8.15 *p.m.*

The members of the Society were entertained at a Smoker held in the New York Aquarium, by Dr. Charles H. Townsend.

SATURDAY, MAY 12

1.00 *p.m.*

Members were the guests of the New York Zoölogical Society at a luncheon held in the Bronx Zoölogical Park, and an escorted tour of the exhibits.

At a meeting of the Directors on May 8, the present editorial board was reappointed and thanked for its past services. At the annual business meeting the present officers were reëlected, and the five directors whose terms had expired were reëlected to serve an additional term of office as the class of 1934–1936.

The following summary of membership and subscription conditions was presented:

New members elected at the current meeting	50
New subscriptions added since the last meeting	9
Total gross additions to the mailing list of the Journal	59
Resignations since last meeting	38
Deaths reported	10
Number delinquent in dues two years	72
Number delinquent in dues one year	72
Number of honorary members	4
Number of life members	59
Number of annual members	761
Total present membership	824
Number of subscribers	139
Total present mailing list	804

The corresponding secretary pointed out that though the membership list showed a decrease from the preceding year that this was principally due to the dropping of a large number from the roster who were delinquent in dues for three years, and that the great shrinkage in paying memberships characteristic of the past four years had definitely stopped.

Of the ten members whose deaths were reported two were charter (*) members. The ten were: Walter Beick, B. A. Bensley, *Davidson Black, R. N. Davis, E. H. Eaton, Benjamin T. B. Hyde, John K. Strecker, *John E. Thayer, Harry C. Trexler, Bessie A. White. In addition to these, the deaths of two former members, A. Brooker Klugh and R. W. Shufeldt were reported.

The committee on the Conservation of Land Mammals, whose informal report was

accepted, reported that progress was being made and that they were following the conditions of the Olympic elk herd, the northern herd of Yellowstone elk, and the snowshoe hare poisoning in the Lake States.

As chairman of the Committee on Conservation of Land Mammals, H. E. Anthony submitted a report by M. P. Skinner on investigations of the Roosevelt elk on the Olympic Peninsula. These investigations were carried on for the Olympic Peninsula Committee of the Boone and Crockett Club, of which Mr. Anthony is also the chairman, and were submitted to the American Society of Mammalogists as an important step in the conservation of one of our finest game species. Mr. Skinner spent fifty-two days, October 10 to December 6, 1933, in the Olympic Peninsula and gathered much valuable data on the condition of the scattered elk herds during the four days of open season, October 19 to 22, as well as before and after.

The report of 36 closely typewritten pages consists of information gathered first hand from all available sources on every phase of the elk problem, with recommendations for further study before final action. It ends with three pages of bibliography.

This report was referred back to the committee with the appreciation of the Society and the hope that at the 1935 meeting other reports of investigations being carried on in the same area by the Bureau of Biological Survey, the Forest Service, the National Park Service, and the Washington State Game Commission would be available so that a practical plan of management could be established.

REPORT OF THE COMMITTEE ON ECONOMIC MAMMALOGY 1933–34

In its last annual report the Committee on Economic Mammalogy mentioned the desirability of federal regulation and control of the transplanting of native mammalian species from one section of the country to another. As an example of the need for such regulation and control, one of the western members of this Committee cites the recent additional plantings of American wapiti in the vicinity of Mt. Rainier National Park, in which the native form is the Roosevelt wapiti.

A letter from Mr. George M. Wright of the Committee contains an encouraging comment on the present situation of the dwarf wapiti of California. Last October the entire Yosemite herd of 28 head was removed to Owens Valley, said to contain ideal conditions for these wapiti. Negotiations are now under way to secure, in addition, a part of the herd of dwarf wapiti in the Button Willow district of the San Joaquin Valley, for removal to Owens Valley. Owens Valley is owned and administered by the municipality of Los Angeles as a water district. As a result of this action, Mr. Wright feels that the dwarf wapiti have been rendered safe from the possibilities of immediate extinction, but that the situation cannot be considered wholly satisfactory without the establishment of additional reservations.

Among current projects of the National Park Service which deserve the support of every mammalogist may be mentioned, first, the proposed addition of Big Bend of the Rio Grande to the National Park System, whereby would be preserved, among others, such species as the peccary, the Texas fan-tailed deer, the Arizona white-tail, and the Mexican bighorn; and second, the proposed extension of Glacier Bay National Monument to approximately twice its present size—a step of great importance toward the permanent preservation of the Alaska brown bear.

Finally, the Committee wishes to emphasize again certain points mentioned in its last annual report, especially the need for detailed studies of the present status of such valuable fur-bearers as the otter, the fisher, and the marten, and for the establishment of an antelope preserve in southeastern Oregon.

Other committee reports were read and adopted.

The following resolution was passed at the final business session:

RESOLUTION CONCERNING THE PROTECTION OF SEA LIONS

WHEREAS, a Bill removing protection from the sea-lions of Alaska is now before Congress, and

WHEREAS, there is no conclusive evidence that any such step is economically justifiable or advisable, and

WHEREAS, these mammals congregate in large rookeries where those hostile to them may destroy immense numbers, thereby threatening their extermination before their decimation can be generally known,

Therefore be it Resolved, That the American Society of Mammalogists, an organization devoted to the study of mammals and their relations to man, earnestly protests against the passage of this Bill.

The Society also expressed by resolution its thanks and appreciation to H. E. Anthony, W. Reid Blair, Walter Granger, Robert T. Hatt and H. C. Raven of the Local Committee for their arduous and unselfish labors in providing for the comfort and convenience of the visiting members; to the officers and staff of The American Museum of Natural History for the hospitality shown the Society; to the New York Zoölogical Society, to Director Blair and Director Townsend for the splendid entertainment provided members visiting the Aquarium and the Zoölogical Park.

An invitation extended to the Society to hold its annual meeting of 1935 at the Carnegie Museum in Pittsburgh was unanimously accepted and the exact time of the meeting left to the determination of the local committee.

RECENT LITERATURE

Charles T. Vorhies and Walter P. Taylor. THE LIFE HISTORIES AND ECOLOGY OF JACK RABBITS, LEPUS ALLENI AND LEPUS CALIFORNICUS SSP., IN RELATION TO GRAZING IN ARIZONA. Univ. Arizona College Agric., Agric. Exper. Sta., Tech. Bull. no. 49, May 31, 1933, pp. 471–587, 5 figs., 12 pls.

This paper we judge to be on most scores the best American monograph yet published in the province of mammalian natural history. The technique employed in the field through the long years devoted by the authors to their study of the jack rabbits and in assembling the resulting data was admirably planned; and the interpretations and discussions set forth in the paper have been formulated upon the basis of the most modern ecologic thought. The bibliography of over 100 titles demonstrates the breadth and modernity of the authors' general preparation to write such a monograph.

With due consciousness of the impossibility of doing full justice to the paper, we cite a few of the findings and ideas of Vorhies and Taylor respecting the natural history of jack rabbits as studied by them in Arizona. The white-sided and gray-sided species, although rather closely related, occur in part upon common ground. The first, even though the larger in size, is much the more restricted in general range, therefore probably less flexible in tolerance to habitat conditions; and its breeding potential is lower (litter of *alleni*, 1.93, of *californicus*, 2.24). Neither species habitually penetrates heavily grassed territory; each finds its metropolis on rather sparsely grassed, partly weedy or bushy ground, where sites for "forms" can be situated beneath shelter. In Arizona there is little indication of any large fluctuation in denseness of population. This lends support to the tenet that animals of temperate zones, where the number of species is greater, are less subject to major fluctuations in numbers than those of more northern latitudes where species are fewer and climatic conditions are more extreme. Indeed, within the bounds of the one wide-ranging species *californicus*, we find that the more

northerly populations in the Great Basin are definitely subject to irruptive fluctuation, in contrast with the relative stability of the populations in Arizona.

The economic pronouncements and recommendations in this paper appear to us essentially sound. Vorhies and Taylor say, among very many wise things: "The fact that man as yet understands very little of the natural world is an excellent argument that he should be cautious in upsetting nature's arrangements." "Much skepticism has been expressed, of late, of the reality of the balance of nature. We are of the opinion, however, that the phrase is pertinent and accurate. . . . . [Man] may abstract a weight here or put another there, but he can never destroy the balance any more than he can prevent the conservation of energy. The new balance may be more to his liking, or it may be extremely harmful to him." "Under conditions of overgrazing and of misapplied control of predators, there is almost sure to be a jack rabbit and rodent problem." "The best control program is one which interferes least with the orderly relationships of natural species. . . . . Natural equilibrium must be increasingly relied upon in administration of natural resources."

For controlling jack rabbits where doing appreciable harm, and where natural, biological control does not for the time-being suffice, the authors specify, on the basis of proven effectiveness and ultimate cheapness, (1) fencing [of cultivated ground], (2) shooting with a .22 calibre rifle, (3) poisoning with alfalfa bait. The latter method is distinctly advised against, for reasons clearly stated.

It is difficult for us to find points to criticize in this paper. Conscientious precision in handling fact and interpretation is an outstanding quality of it. Yet, while granting that man and his activities must be given due consideration as one element in the biotic environment of any animal as intensively studied as were these jack rabbits, we are left with the slightly uncomfortable feeling that the strictly biological nature of the paper has been somewhat sacrificed to meet a certain "agricultural" pressure. To be sure, as the title indicates, and as the auspices under which the work was done perhaps required, those interpretations probably had to be stressed which have bearing upon man's own interests. However, may we not look forward hopefully to the appearance some time of that still more scientifically ideal kind of monograph of a mammal, which will be absolutely impersonal—as entirely free from human self-consciousness as are many contributions in the fields of physiology or anatomy? And might not such a "purely" ecologic monograph prove, secondarily, even more soundly significant for man's own welfare than the current "economic" type of monograph?

Because a large proportion of their discussion has important bearing upon the more general problems of mammalian ecology, we feel that we can hardly be too urgent in recommending that Vorhies and Taylor's Arizona jack rabbit paper be read and studied far and wide, especially by zoölogists who contemplate serious field investigation of any sort of vertebrate animal.—J. GRINNELL AND R. T. ORR.

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COMMENT AND NEWS

ACTIVITIES OF THE AMERICAN COMMITTEE FOR INTERNATIONAL WILD LIFE PROTECTION DURING 1933–34

Report for the American Society of Mammalogists' Annual Meeting, May 8, 1934

The American Committee for International Wild Life Protection feels honored to present a report of its activities for the past year before this gathering. The American Society of Mammalogists has been represented on our Advisory Boards since our inception over 4 years ago, by Dr. Joseph Grinnell of California.

Since our paper at last year's meeting we have published 2 reports; one on African game protection, and the other, issued this spring, on a history of federal migratory bird control, by Dr. John C. Phillips, chairman of our committee. Copies of both these are available free of charge at our office in the Museum of Comparative Zoology, Cambridge, Mass., and I have a few copies of Dr. Phillips' report here with me for distribution. We had hoped to have ready for this occasion a report on the present status of the Musk-ox in Canada and Greenland, with an account of attempts at domestication and introduction. However, this is only just going to press. It will be available at our office within a short time. Next year we are hoping to publish a revised edition of our African report, as many changes in the status of African wild life have occurred within the past year; these changes in particular arising as a result of the London conference last October for the protection of African flora and fauna.

A revival of the London convention of 1900, which was never ratified, this 1933 convention marks a big forward step in international wild life protection. Dr. Phillips was the official U. S. Observer at this gathering and I wish he could be here to tell you a little of its accomplishments and its far-reaching effects in many places besides the African continent. However, the main provisions of the convention may be described as follows:

1. The establishment of national parks or strict natural reserves—i.e., permanently established sanctuaries under definite regulation.

2. The provision of game reserves preliminary and supplementary to national parks.

3. The protection of certain scheduled species was declared to be of special urgency, and provisions for the strict regulation of the trade in trophies were laid down.

4. The use of motors and aircraft, dazzling lights, flares, poison, nets, pits, enclosures and surrounding by fire was recommended to be prohibited wherever possible.

To become effective this convention must be ratified by 4 powers with African possessions and every effort is being made to bring this about.

At our annual meeting last December we elected the following new members to our Advisory Board; Frank B. Foster, for the Philadelphia Zoological Society; Childs Frick, for the American Museum of Natural History; Madison Grant, for the Boone and Crockett Club; Edward Mallinckrodt, Jr., for Washington University, St. Louis; John

T. McCutcheon, for the Chicago Zoological Society; Robert T. Moore, for the California Institute of Technology. Dr. Thomas Barbour was transferred to the Executive Committee to fill the vacancy left by the resignation of Mr. George Pratt.

On account of ill health Dr. Derscheid has had to resign from the directorship of the International Office for Nature Protection at Brussels, but the efficient work of Dr. Tordis Graim will be continued. With new legal statutes and personnel we anticipate renewed activity from this important co-ordinating bureau. We have been in close correspondence with Dr. Van Tienhoven who was also at the London conference as official observer for the Netherlands government. The Netherlands committee for International Nature Protection of which he is director has just issued another important yearbook, no. 10. The British fauna society played a very active part in promulgating the London conference and we have also been in correspondence with them on various matters through the year. The French Conseil International de la Chasse was represented at the London Conference by the secretary, Count d'Adix. At his request we sent 150 copies of Dr. Phillips' report for distribution at the annual meeting of the Council at Warsaw, Poland, early in April.

As mentioned last year we secured through the American Foreign Service a great fund of information on wild life protection in various countries. The colonial game departments in Africa are also including our office on their mailing lists for annual reports, so that together with information received from many other parts of the world through individual contact and sympathetic organizations, we are building up a very useful file of material on international wild life protection. This is at the service of any member of the American Society of Mammalogists.

Problems of a varied nature have come to our attention during the past year. For instance, there is the question of joining with other animal protection organizations to suppress fake nature films, many of which involve highly unnatural and cruel situations for the animals used in the production. There is the problem of controlling unscrupulous Americans who go on so-called "collecting expeditions" to foreign countries. Too often backed by the name of some American scientific institution they have secured permits to take rare mammals and birds without valid reason for thus endangering the species. We have also been called upon to defend the reputation of American sportsmen. The case of young Mr. George Vanderbilt, who was supposed to have hunted lions in East Africa with fishhooks entailing barbarous cruelty, was given wide publicity, especially in England. But a statement eventually secured from Mr. Vanderbilt showed that this entirely false account of the proceedings was transmitted by the news reporter who wrote up an interview with Mr. Vanderbilt about his hunting trip.

In spite of the great strides that international conservation has made within the last few years, there is still a great deal to be done, and quickly, if we are to save certain species from sharing the fate of the passenger pigeon, the European wisent and the South African bluebuck and quagga. For instance, as a tsetse fly control measure of questionable value, nearly 60,000 animals (including reptiles) have been destroyed by government hunters in Southern Rhodesia in the past 4 years. This entailed the slaughter of over 2000 head of big game a year. The Swaziland government tried cutting down the number of wildebeeste in that territory by using poisoned water, with a consequent damage to many other forms of wild life. However, these methods were stopped as a result of pressure brought to bear by citizens and people outside who were interested in game preservation. Despite rigid protective laws in certain colonies, the black Rhinoceros is rapidly disappearing all over Africa, as a result of a trade demand which makes poaching profitable. For example, over 2000 lbs. of horn passed through a single customs post on the Congo-Uganda border in 1932 and nearly 3000 lbs. had already been registered by June 1933. A report recently published by a French army doctor lately retired from colonial service, describes appalling game slaughter going on in French

Equatorial Africa. This is carried on by natives armed with modern rifles or surrounding game with fire. Our informant once had occasion to save a herd of over 150 elephants from being burned alive in one of these fire-rings. Such holocausts no doubt explain the famous "elephant cemeteries" one hears so much about. In addition to the native hunters, professional white hunters add to the rapid depletion of Africa game by selling the meat to supply highway or railroad construction gangs or to native workers in government mines.

From all reports, both published accounts and personal correspondence, the game situation in India is badly in need of attention. Take the case of only one of its big game animals, the rhinoceros. The oriental market for rhino horn which makes this substance literally worth its weight in gold, "is directly responsible for the existence of well-armed gangs, whose depredations are largely the cause of the disappearance of the great Indian rhinoceros." With the fortunate precedent set by the recent London conference on African game, it is hoped that another international conference may be convened within a few years to consider the most urgent problem of saving certain remnants of Indo-Asiatic fauna.

In the field of economics and industry, to say nothing of the academic and scientific world, we are slowly realizing that the highest achievement comes only with international co-operation. The same applies to wild life protection. As an important world state and one which abroad is held to be a model in conserving wild life in National Parks,[1] the United States should be willing to accept the responsibilities of leadership. We should be willing to share our experience in wild life conservation and to learn from the experience of other nations. In order to do this we must have a coordinating organ and this work our committee hopes to fulfill to the best of its ability until a better way is found. However, this can be done successfully only with the constant co-operation of our supporting organizations. This applies particularly to the American Society of Mammalogists, which we feel to be very sympathetic and understanding of efforts to save wild life throughout the world from going down before the advance of civilization.

Respectfully submitted,

ELISABETH HONE

EDWARD WILLIAM NELSON

Dr. Edward William Nelson died in Washington on May 19, 1934, at the age of 79. The immediate cause of his death was heart trouble, from which he had suffered for many years.

Dr. Nelson was chief of the U. S. Biological Survey from 1916 to 1927; he retired from the Survey in 1929, but continued his activities as Associate in Zoology in the National Museum until within a few weeks of his death.

He was an Honorary Life Member of the American Society of Mammalogists, and served as its President from 1921 to 1924.

It is expected that a biographical sketch of Dr. Nelson will be presented in the November number of the Journal.

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[1] See statement of Dr. Victor van Straelen, Natural History, vol. 34, no. 2, pp. 197–198. March–April, 1934.